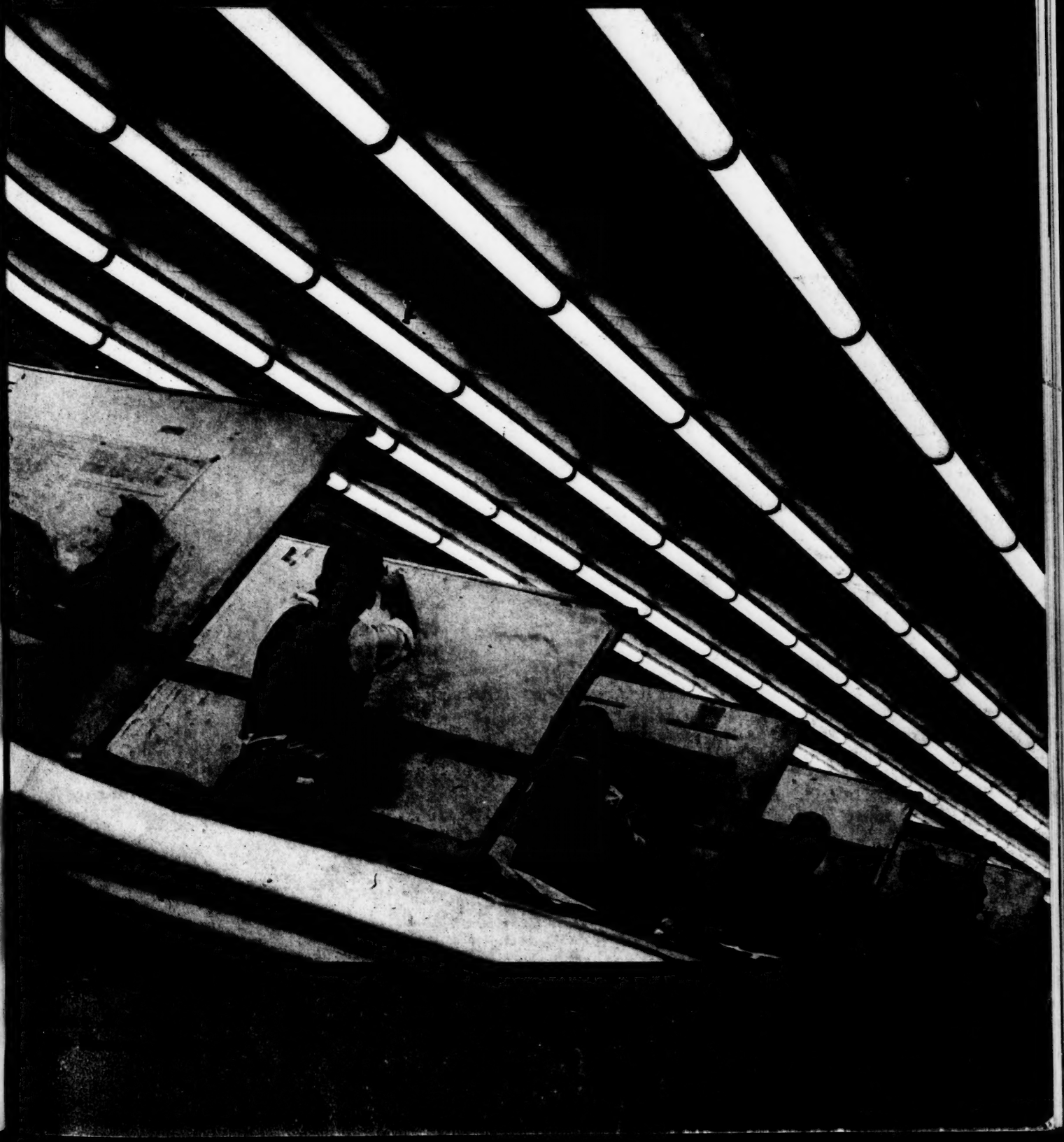
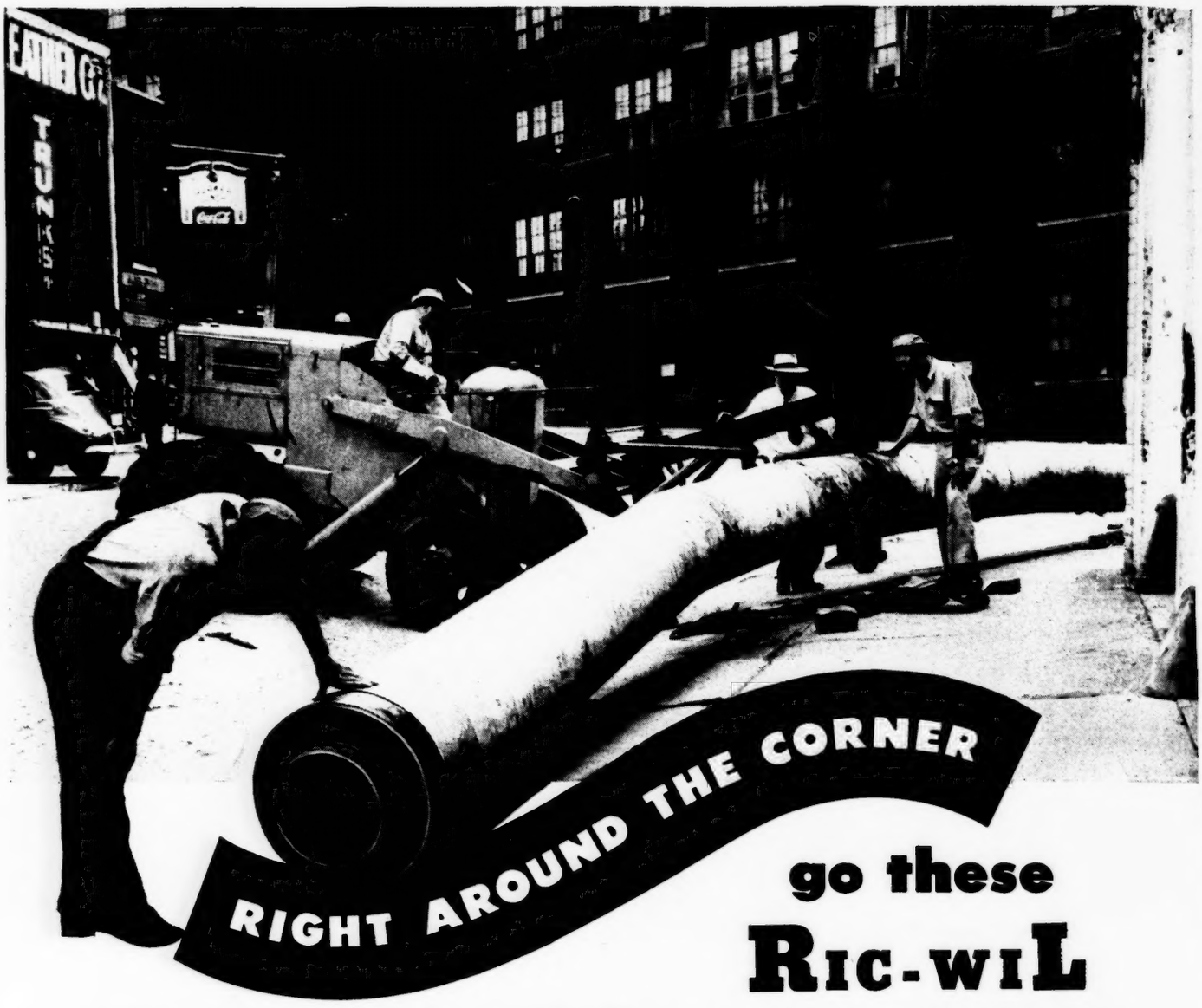
HEATING AND VENTILATING





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HEATING AND VENTILATING

A MONTHLY MAGAZINE FOR ENGINEERS AND CONTRACTORS CONCERNED WITH THE DESIGN AND APPLICATION OF AIR CONDITIONING, REFRIGERATION, PIPING, AIR SANITATION, HEATING AND VENTILATION IN BUILDINGS

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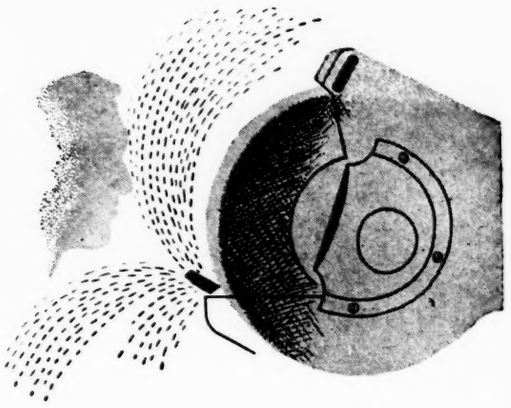
PUBLISHERS OF MACHINERY & MACHINERY'S HANDBOOK
The INDUSTRIAL PRESS

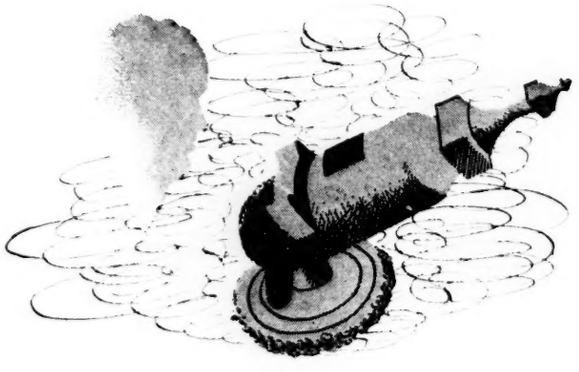
THIS MONTH'S COVER

Section of drafting room in Westinghouse Steam Division Works at Lester, Pa., showing fluorescent lamps which maintain "daylight" the clock around. More than one-third mile of lamps light the 3,000 sq ft room, one of the largest drafting rooms in the world.

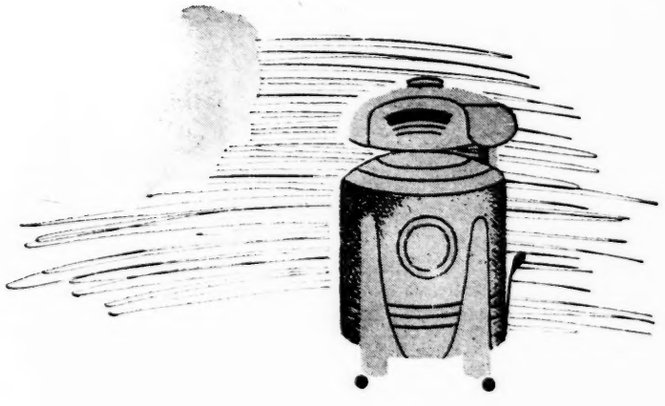
they're strong for standardization



Electrical Engineer, machine tool company, says: "I think designers will save time in the long run if they decide, at the start of a job, to use standard motors. We'll eliminate exhaustive engineering tests we used to make on fractionals. With horsepower, service factor, breakdown torque, and starting current all rated on a clear-cut, uniform basis we'll know *in advance* that the motor will do the job."



Chief engineer, portable tool plant, says: "I simplify design when I specify series-motor parts with NEMA standard dimensions for our portable tools. By designing tool housings to take parts conforming to these standards, I simplify case construction, obtain interchangeable motor design, and lower overall costs."



Vice-President, washing machine company, says: "The use of *standard* washing machine motors helps our dealers to give dependable service. With standard motors, the service man can take full advantage of the motor manufacturer's motor-exchange and repair-service plans—take the headaches, and delays, out of motor repairs or replacement. He can be sure that the motor he puts back on the job will perform as it should."

Washington News

LORING F OVERMAN

WHEN Congress finally decided to go home on October 19, first impression might be that it had accomplished only one thing—established a record for holding the longest peacetime session in history.

Subsequent analysis revealed that it did several things of direct and immediate interest to members of the heating, ventilating and air conditioning professions and industries, besides several others which will have an impact of as-yet undetermined force in years to come.

In appraising important legislation completed, any tendency to conclude that the 81st Congress slowed down the more liberal proposals should be balanced against the fact that everything receiving favorable action was extremely liberal, to say the least.

Thumbs Down

True, Congress refused to accept last November's elections as a "mandate" to repeal the Taft-Hartley law, to inaugurate a civil rights program, or to establish a health insurance medical aid program. Also turned down were administration demands for increased taxes, and for standby authority to impose an endless list of government controls "in the event of an emergency."

Thumbs Up

Approved—among others directly concerning HEATING AND VENTILATING readers—was the Federal slum clearance and low rent housing program, and one authorizing advance planning of a $300 million program of public works. Extension of rent controls through June 30 of 1950 may also be said to have had some bearing upon new construction in the apartment field.

For those in the manufacturing ends of the industries, increasing of minimum wages to 75c per hour will not go unnoticed. For it will put a floor under wages for the unskilled, but may force a consequent upward revision in wages paid skilled employees as well.

Heating, ventilating and air conditioning designers and producers concerned with export business and military construction will be concerned with the passage of the North Atlantic Treaty and related Military Assistance Program, and extension of the Reciprocal Trade Agreements program.

Reorganization?

Another approved measure which looks good on the record, but which is difficult of enforcement, granted general presidential authority to reorganize executive departments and agencies, with increased economy as the objective. Granting of this authority appears all the more remarkable since it embodies recommendations of the Hoover Commission. Proponents claim that passage by the 81st Congress of six of the score of recommendations made by the commission promises a potential saving of approximately $1.25 billion annually.

Major obstacle to accomplishment of the desired economy objective is the fact that while Congress, and constituents, favor economy in general, specific efforts to bring it about inevitably tread upon pet projects and political toes. Typical reaction was that of the Navy, when Defense Secretary Johnson announced budget slashes.

Although realizing the difficulties faced, proponents of the Hoover Commission plans—represented by the Citizen's Committee for the Hoover Report—are prepared to take the bull by the horns and insist that the time for decision is now or never. At the next Congressional session, opening January 3, the Committee is prepared to introduce new legislation which would force agency heads to take specific steps to streamline their departments. Many of the enacted and pending bills merely "authorize" the officials to act, and some agency chiefs are known to oppose the proposals.

Not entirely discouraged, the Citizens' Committee analysis of work of the 81st Congress observes: "During three and a half months since six major Hoover Commission bills out of seven were passed, more reorganization has been accomplished than at any previous time in the nation's history. The Hoover report cannot make or break the Federal budget, but it can mean the difference between a surplus or a deficit."

The principal Hoover-sponsored measures so far approved are the Tydings Act, aimed at unifying the armed services, with an eventual saving of $500 million a year, and the creation of the General Services Administration, intended to save $250 million annually by merging the Government's buying, surplus-selling, and record-keeping operations.

Other adopted changes include a partial streamlining of the State Department, increasing the pay of top officials and many lesser civil servants, and authorizing a Deputy Secretary of Defense. The Hoover report as a whole—promising a $4 billion annual saving—suffered a major setback when Congress refused to accept it in its entirety.

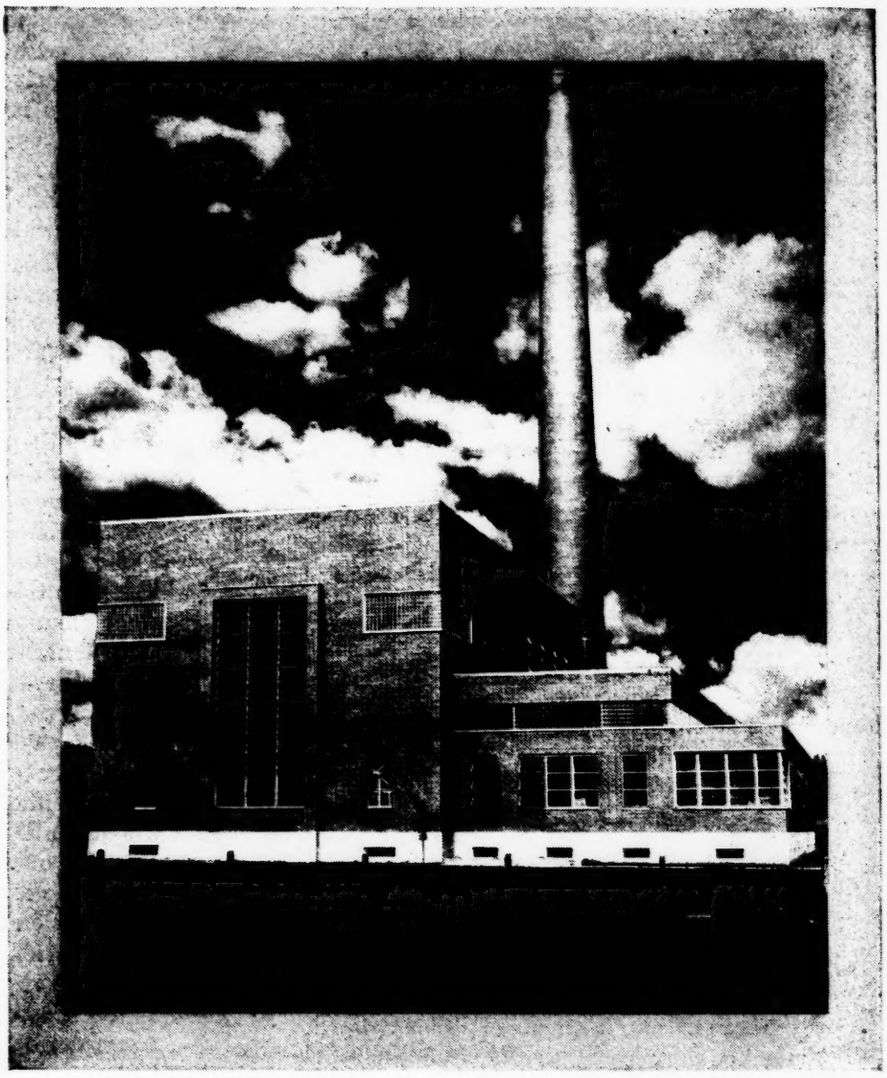
Need Obvious

The need for further action on the Hoover recommendations is evident when it is known that, despite the $1.25 billion saving credited to the adoption of six Hoover proposals, the overall Federal budget for the 1949-50 fiscal year will be only about 1% below the $42 billion which was asked for by the Administration last January.

New Expenditures

Answer to the disappearance of the $1.25 billion is the addition of such new programs as the slum clearance and public housing projects. Employees dropped from various agencies in the Hooverized economy pro-

This hospital power plant cures pipe ills with BYERS WROUGHT IRON



Since water is the life-blood of every power plant, an unfailing supply is of first importance. In the recently-completed plant at the Kankakee (Illinois) State Hospital, the job of safeguarding this service was entrusted to wrought iron. Over thirty tons of Byers Galvanized Wrought Iron pipe, in sizes from ½ to 8-inches, was installed in the supply system, and in extending the water distribution system in certain adjacent areas. The material was already being utilized for maintenance work on condensate return lines in the steam distribution system.

Power plants in all sections of the country are using this same time-tried method of protecting water lines. The wisdom of the choice is confirmed by many comparative records of wrought iron still serving in water lines after thirty—forty—and even fifty years, in areas where low-first-cost piping materials required repairs and replacement in a fraction of the time. The condensate return application is another that follows established engineering precedent. Condensate is always aggressive, and wrought iron has proved itself remarkably successful in resisting attack.

The corrosion-resisting properties of wrought iron are the direct result of its unusual composition and structure, which are duplicated in no other material. Tiny fibers of glass-like silicate slag, threaded through the body of high-purity iron, halt and disperse corrosive attack. These fibers also help to anchor the initial protective scale, which shields the underlying metal.

It is helpful, in applying wrought iron in the many places where it can reduce repairs and maintenance, to know something of how it is made, how it resists corrosion, and where it has been used. All this is digested in the booklet, THE A B C's OF WROUGHT IRON. May we send you a copy?

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, Salt Lake City, San Francisco. Export Division: New York, N. Y.

Corrosion costs you more than wrought iron

gram are now flocking to new jobs in the Housing and Home Finance Agency, which is charged with administration of the new housing program.

N. S. Keith, director of the slum clearance and urban redevelopment programs, explained all this on October 13 at the National Planning Conference of the American Society of Planning Officials. "We are now at the very beginning of this new program," said Mr. Keith. "From the standpoint of the Housing and Home Finance Agency, that statement is very literally exact, since only this week are we receiving the administrative appropriations needed to staff our initial organization and to put that staff to work on the many policy determinations which must be made before we can begin to do business with the cities.

"During the three months since this legislation was enacted we have been doing as much preliminary work in this direction as our extremely limited staff resources have permitted. We can move forward rapidly now that our organization can be established."

The news that savings at one point in Government are usually counteracted by spending somewhere else must be very discouraging to some communities which have already taken their economy cuts without a whimper in the hope of aiding a good cause. Take Boise, Idaho, for example, where the board of directors of the Chamber of Commerce authorized manager Earl C. Reynolds to make the following statement: "I cannot for the life of me see how we can urge our Senators and Congressmen one day to cut down on our Government spending, and the next day turn around and scream to high heaven because the shoe happens to pinch us where the cuts are being made.

"We here in Idaho have suffered two distinct cuts in defense installations. However, it is by no means our intention to campaign to have these cuts restored. We know that the saving must be made someplace, and we might as well take our medicine with the rest of them."

"News for you, Brother"

Borrowing the comedian's quip, "I got news for you, brother," there aren't going to be any savings in Washington—despite sacrifices in Boise and scores of other communities—as long as voters cast their ballots for handouts instead of legislators.

And legislators aren't going to really legislate as long as they know that their return to Washington is dependent upon supporting measures that have the appearance of giving their constituents something for nothing. Some feel that it is already too late for Boise-ites and others to get mad enough to reverse the "gimme" trend. Others contend there is still time—barely time.

Housing Surprises

Meanwhile—and before the Federal housing program has had time or money to go into action—the private housing industry came out with a major surprise when the September figures were tallied. During that month, according to the Bureau of Labor Statistics, the industry reported 100,000 new housing starts. The month's total, 22% above last year's September level, was the highest in the country's history. This important gain, in a month when housing construction normally slackens off, brought the housing total for the year above the 1948 figure, despite a rather slow start.

Two reasons are given for the upward swing. First, builders are concentrating on less expensive homes and tapping a market ready and able to buy. Second, many who have been holding off for a real break in prices have apparently concluded that prices aren't going down too much in the foreseeable future, and that they might as well go ahead.

Five communities—Detroit, Los Angeles, Houston, Cleveland, and Boston—report an active market for homes in the $7,500 to $10,000 price class. In Los Angeles, 50% of all building permits are for houses to sell below $7,800. A year ago only 15% were below that level.

If the building industry finds it profitable to build lots of small houses instead of a few premium priced ones, the industry may find itself mighty busy when the Federal program begins to click. As of September 30, the Public Housing Administration had received applications from city housing authorities covering 284,116 units of low cost housing. Under the law, only 270,000 may be authorized during the first two years of the program—a total of 810,000 for the first six years.

Costs Decline

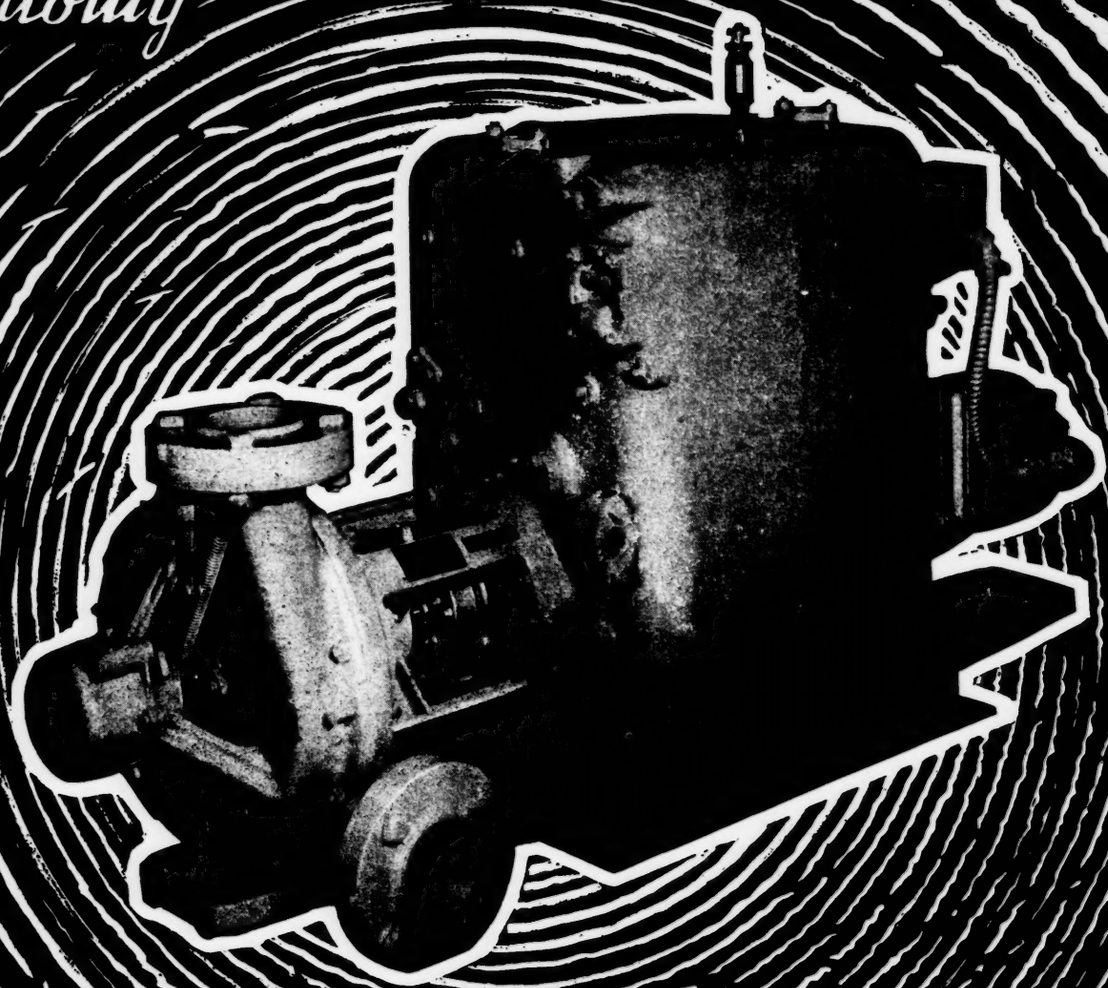
Further evidence of the changing in the housing picture is contained in the Department of Commerce estimates of construction costs. These costs declined in nine of the 10 months since the all-time peak was reached in October, 1948. As measured by the Department of Commerce from city indexes, residential costs in August were almost 8% below the 1948 peak. In spite of this decline, however, August costs were still more than twice as much as average monthly costs during 1939.

Despite an upturn in construction starts, production of some building materials and equipment declined during the January-July period, latest for which such data are available. The composite index for the period was 11% below the comparable period of 1948. The 10 materials showing the largest decreases in production during the first seven months of this year were: mechanical stokers (down 65%); cast iron radiation (down 62%); galvanized range boilers (down 36%); asphalt prepared siding and felts (down 25%); asphalt prepared roofing (down 22%); cast iron soil pipe and fittings (down 18%); warm air furnaces (down 17%); rigid steel conduit and fittings (down 16%); lumber (down 16%); and hardwood flooring (down 9%).

What Next in Congress?

Washington considers the present Congressional recess merely the halftime, with all contestants to take their places again on January 3, playing the same positions, and facing the same goals. But with 1950 elections only months away, political considerations will—if such a thing can be possible—carry the ball in the pinches.

Centralized Heating Economy



A RETURN LINE VACUUM PUMP THAT CUTS HEATING COST.

This unusual pump needs no electric current, cutting out greatest item of pump operating expense.

More important, this pump insures absolutely uniform circulation in system. That means continuous steam economy.

Simple, compact, one moving element, no wearing parts, no internal lubrication. Bulletin No. 203 gives the facts. Your copy is waiting.

THE NASH ENGINEERING COMPANY
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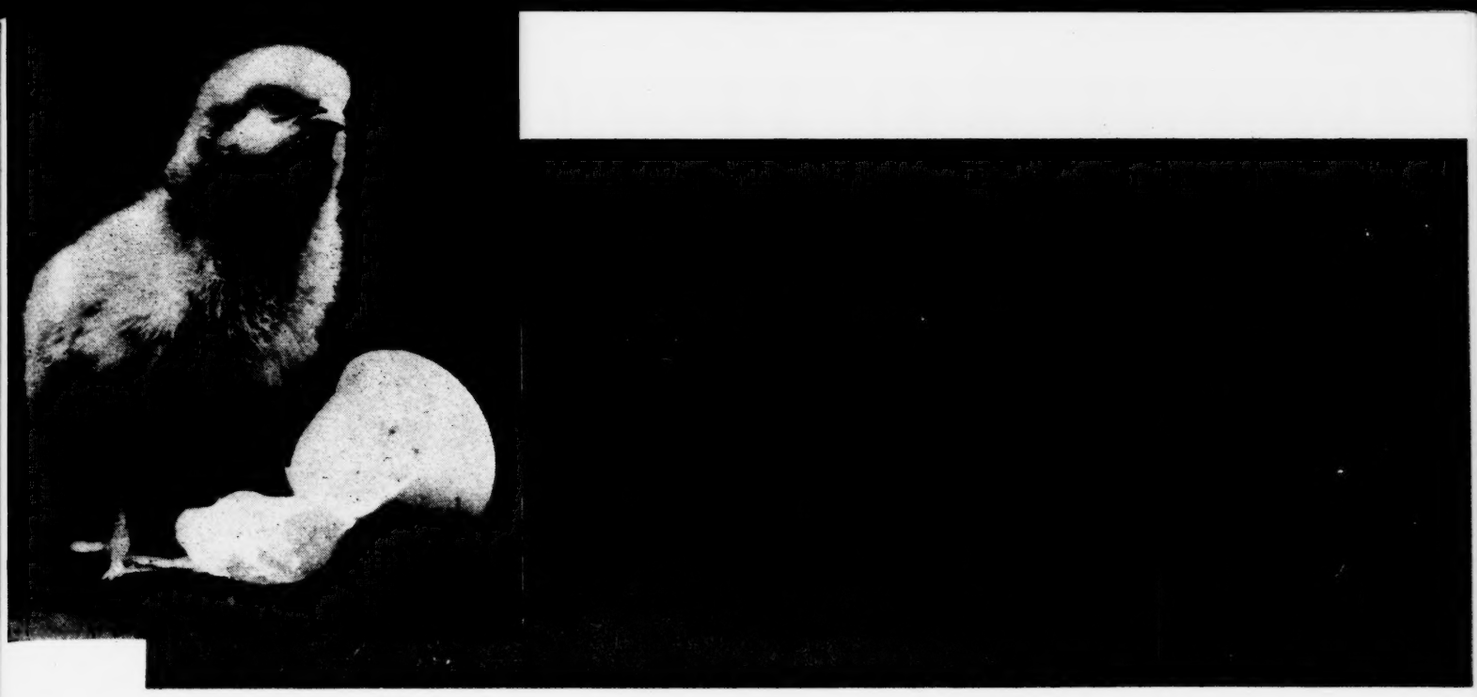


More than 900 million chickens were reared in the United States last year of which 350 million were commercial brooders. Those in the poultry industry expect expansion of the number of commercially raised chickens as compared with those farm raised. Many of the 1948 hatchings were reared under conditions of radiant heating, with a resulting drop in mortality rate. Design details of such heating systems are described in detail.

RADIANT heating has been found to give excellent results, not only in providing the best comfort conditions for the human body, but also in connection with various kinds of animal life. This writer has designed radiant heating systems for mice, chickens, reptiles, and several other species of the animal world, and in every case considerable improvement has been noted in the health, growth, and development of the occupants. Where mice and other rodents have been reared for laboratory purposes, it has been found that breeding takes place much more rapidly than with other methods of heating, and the development of the young has shown a marked improvement, with considerable reduction in the mortality rate.

One of the more recent and profitable applications of radiant heat is in connection with brooder houses for chickens. Latest reports from the United States Department of Agriculture, however, indicate that only 556,340,000 farm chickens were reared in America in 1948, which is somewhat less than the average for the last ten years, as indicated by Table 1.

It will be noted from Table 1, that commercial broiler production until 1948 amounted to less than one-third of the total number of chickens raised, but these reached a record level with about 1,062 million pounds of live weight produced in 38 States in 1948—20% more than in 1947. The price was also better, being 35.9 cents per pound live weight, compared with 32.1 cents in 1947. Most people connected with the poultry industry expect further expansion in commercially raised chickens in future years relative to farm raised chickens, as farm chickens are essentially a by-product of raising pullets for laying flock fill-ins.

Many of the 1948 hatchings were reared under the ideal conditions of radiant heating, and, consequently, the mortality rate was much lower because of better conditions. This, undoubtedly, resulted in a larger percentage maturing, and a more profitable business for some. Since one per cent in the death rate is equivalent to a loss of about 4½ million layers, a reduction in the mortality rate is a big saving to the country.

POULTRY HOUSE DESIGN

Generally speaking, the new buildings, which are looked upon as being somewhat of standard design, are one-story high, 220 ft long x 20 ft wide, as shown in Fig. 1. Invariably these are of wood frame construction with 2-inch x 4-inch studs for walls with wood sheathing. The roof is single pitch, pitching from the south down to the north wall. The glass is in the south wall in order to have full benefit of the sun during winter months. In some cases the sides

TABLE 1—PRODUCTION OF FARM CHICKENS AND COMMERCIAL BROILERS IN THE UNITED STATES

Year	Commercial Broilers Produced,* Millions	Farm Chickens Raised*†, Millions	Commercial Broilers as Per cent of Total Chickens
1935-39	70.4	664.4	9.6
1940	142.8	633.7	18.4
1941	191.5	745.0	20.4
1942	228.2	844.3	21.3
1943	285.3	1,001.4	22.2
1944	265.0	832.1	24.2
1945	345.6	914.8	27.4
1946	275.6	745.8	27.0
1947	283.1	745.4	27.5
1948	350.7	556.3	38.6

*Commercial Broilers include all young chickens of the heavy or cross breeds—2 to 4 lb live weight, raised for meat, and from which pullets are sold as broilers, as well as cockerels.

†Does not include young chickens lost.

are built of bricks, but this depends largely on the locality and personal choice of the breeder. The center section of these buildings, 20 ft long, is constructed with two floors, and the upper floor is used for feed storage. Each 100 ft side of the center section is usually divided into five 20 ft sections, and the divisional walls may be made solid when different temperatures are required for each section, or 2-inch x 4-inch studs covered with poultry wire may be used if one temperature is to be maintained throughout. The floor is usually concrete and heated from end to end. With frame constructed buildings, it is recommended that the sides and roof be well insulated because this helps considerably in the function of temperature control, and, it does save fuel.

While the design in Fig. 1 is looked upon by some authorities as an acceptable standard, other designs are often selected with good results.

The outside of a two-floor radiant heated brooder house, Fig. 2, is 75 ft wide x 150 ft long. This design has also proved satisfactory. In this case, however, some of the more economical features were omitted, and the pipe coils for the lower floor were placed on a thick layer of broken stone with a fine gravel finish, Fig. 3, the concrete floor being poured on the top of this to a depth of 4 inches. For the second floor, pipe coils were placed on a wooden underfloor supported on joists, Fig. 4, after which the concrete was poured to form the finished floor. Wooden partitions were erected at each column so that the whole of both floors was divided into a series of rooms.

Fig. 2. Exterior of a two-floor radiant heated brooder house.

Fig. 5 illustrates the entire absence of crowding, and although this photograph was taken during very cold weather, it is obvious the chickens were quite content to roam about.

There appears to be two schools of thought in connection with this method of heating. While it seems to be well established that by maintaining a dry and warm floor, the mortality rate of the chicks shows a marked drop as compared with other methods of heating in which the floor and litter is allowed to become cold and damp, (1) some breeders consider that since the chicks are always near the floor where the intensity of radiant heat is high, the heat rays will keep the chicks comfortable irrespective, to a certain extent, of the air temperatures which surround the body, and (2) others aim to maintain a warm floor, but at the same time provide a predetermined air temperature according to the age of the chicks. The method advocated by (1) is to simply maintain a floor surface temperature of 90F to 95F, without paying any regard to the air temperature. The method of keeping the floor warm and dry at all times, and maintaining a suitable air temperature, appears to be the most successful, and certainly the most reliable, although both methods are worthy of some consideration.

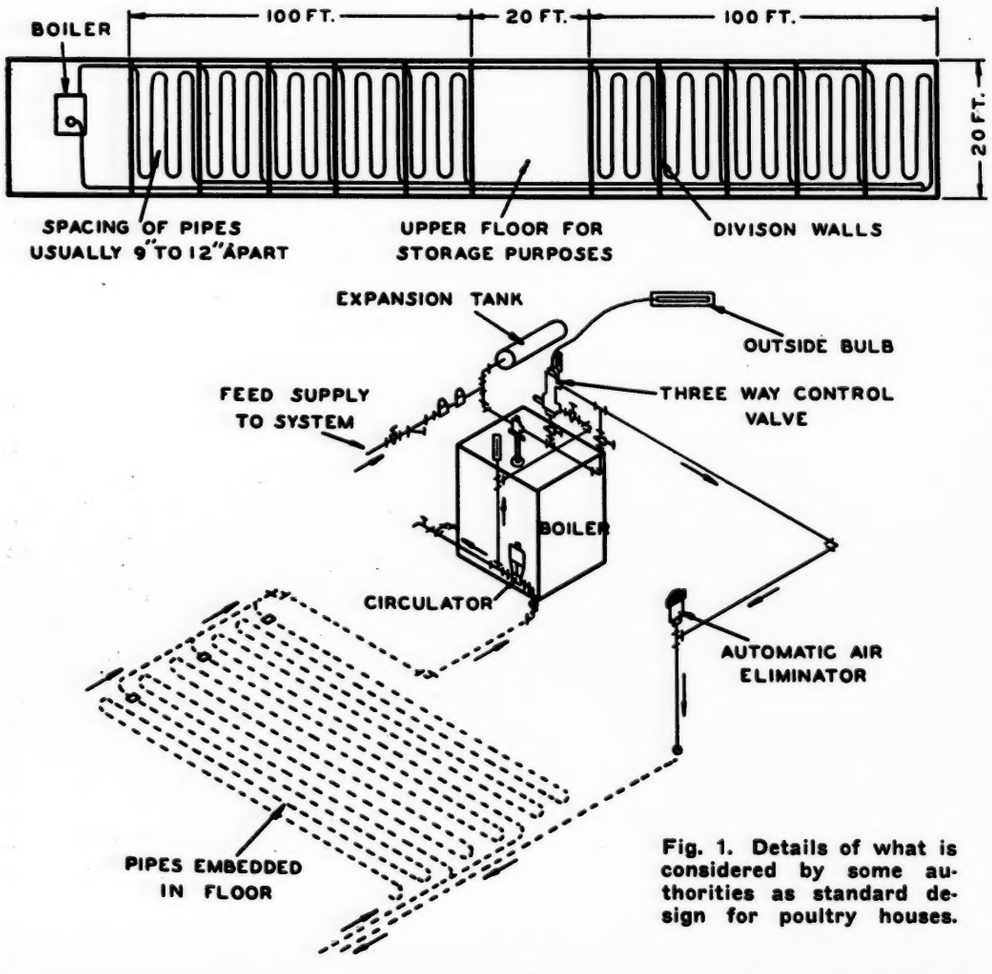


Fig. 1. Details of what is considered by some authorities as standard design for poultry houses.

In both methods the floor is usually heated by embedding hot water pipes in the concrete floor, although where electricity is cheap, good results can be obtained by embedding suitable conductors below the floor surface. Regardless of the heating medium employed, it is essential for the newly hatched chicks that the surface temperature be maintained at approximately 95F. This

Fig. 3. Laying the coils for the first floor of the house shown in Fig. 2.

alone makes considerable difference in the mortality rate, because the baby chicks can find comfort on any part of the floor and will not crowd together for warmth, as is the case with the old method of heating.

Crowding invariably takes place at night when the weather is cold, especially where hovers are provided. With a heated floor the chicks will stay wherever they are and remain perfectly comfortable with less likelihood of contracting disease. Many diseases which attack newly hatched chicks are due to damp cold floors, even though the air temperature may be sufficiently high for keeping them warm. On the other hand, a heated floor will quickly dry the litter and protect the chicks from chills. Since the sand and covering used on the floor are always dry in spite of the droppings, it usually remains unchanged during the life of the chicks. It can be easily cleaned out before the next batch of chicks. With other types of heating it is found desirable to change the sand and covering every two weeks, but with the heated floor the entire mixture of sand, etc., can be removed at the end of the brooder period and sold for fertilizer. It is found also that there is considerable saving in litter, and since litter has always been an appreciable item on the side of costs, this saving makes radiant heating more desirable.

When radiant heating systems were first installed, it was found that less litter was used for it could be kept dry. The tendency now, however, is to eliminate the use of litter entirely, thereby effecting a considerable saving in both material and labor. A further saving has been noted due to less fuel being consumed, which, in many cases, has been quite substantial. With the heat concentrated at the floor level, its effect is localized exactly where it is needed. Consequently, there is less heat loss from the building and less fuel consumed. In some cases, where the heating system has been changed from the older method of hovers and stoves to the heated floors, savings of 25 to 33 1/3% have been recorded.

With brooder houses, as shown in Fig. 1, chicks may be moved into an adjoining section while the droppings are removed, floors scrubbed and disinfected if desirable. Since the floor is heated, it quickly dries after scrubbing and is ready for use immediately. This procedure improves the sanitary conditions and pays off in a very low mortality rate.

Temperature for Chicks and Turkey Poults

When chicks are first taken from the incubator, which is maintained at 103F, their blood temperature is somewhat higher and reaches a temperature of 107F to 108F at the age of six weeks, and remains fairly constant until they reach an age of 12 weeks. Consequently, it is essential to protect young chicks from drafts. During very cold weather any ventilators should be kept closed at least for a week, and perhaps two weeks. During this stage air temperature near the floor is kept at approximately 90F, with a floor temperature of 95F or thereabout. Following this, air temperature may be reduced at the rate of about one degree per day until the air temperature has been reduced to 72F. Some ventilation is necessary after the first two weeks.

In the case of turkey poults, which are considerably more delicate than chicken, it is essential to have only a thin layer of litter, or no litter whatever. If the litter is allowed to accumulate and to become too deep, a mold will undoubtedly develop which will affect the respiratory system of the birds and will considerably increase the mortality rate. Without heated floors, wire netting is often used with good results, since this reduces the risk of dampness and prevents mold forming. However, from statistics taken over the last two or three years, it appears to be much safer and more reliable to have heated floors, providing these are kept clean, dry, and disinfected. Air temperatures are normally maintained at about 5F higher than those for baby chicks, and, consequently, the floor temperatures will be correspondingly higher.

Turkey production is not as high as chicken production, and in 1948 turkey production amounted to 31,732,000 birds, or 8% less than in 1947. The record average price for turkeys in 1948 was 46.7 cents per pound live weight, compared with 36.4 cents per pound in 1947.

Loss of turkey poults in 1948 was the lowest in a 12-year record, being only 13.6%, compared with 20.2% in 1947, and 25.7% average for 1942-46. Loss from disease was about half the usual loss, and no doubt as brooder houses are improved, the per cent loss will be much less.

Fig. 4. Pipe coils on second floor of poultry house placed on wooden underfloor supported on joists.

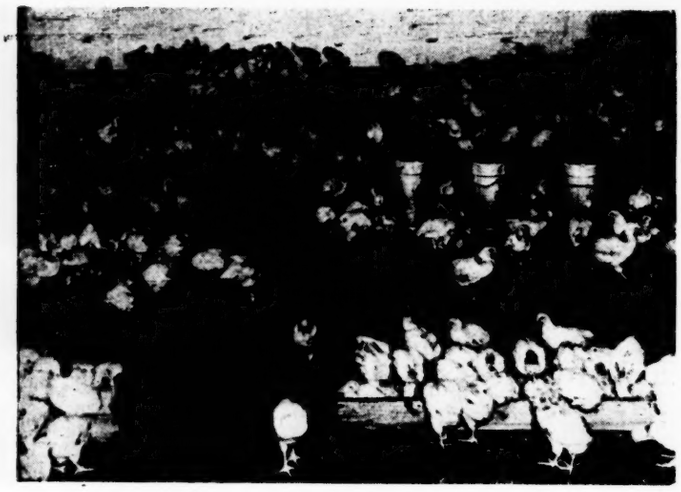


Fig. 5. Heating coils in the floor result in the elimination of poultry crowding.

Partial Floor Heating

Although the type brooder house shown in Fig. 1 is recommended because of its convenience, other types are being erected which, when local conditions are ideal, yield reasonably good results. In localities where the weather is not so severe, and when less capital is available, only a portion of the floors is heated. It is considered by some breeders that in mild localities, and with brooder houses 70 ft x 30 ft, it is possible to rear 2,000 chicks per house and obtain good results with one-third of the floor heated. With a heated concrete strip 70 ft x 10 ft, there is ample room for the chicks to gather and keep warm at night, while the remaining part of the floor can be used for scratching. While this method may appear to offer some advantages from the standpoint of initial costs, there is always the possibility that the chicks will crowd on the heated surfaces at night, or that some will be left on the cold damp floor and suffer in consequence. This writer is of the opinion that it is very much safer to have the whole floor area heated and to regulate the temperature according to the age of the chicks, providing, of course, the surface of the floor is kept sufficiently warm and dry at all times.

Results obtained by heating the whole of the floor are undoubtedly very encouraging, and actual figures which have already been compiled indicate a mortality rate of 1-1½%, compared with a previous 12 to 15%. In addition to this, there has been a noticeable increase in the development of poultry in radiant heated brooders, and gains in weight of 20% have been recorded. It is also conceded that there is greater vitality and virility among birds reared in these houses, and that laying commences several weeks ahead of those birds reared under older methods.

The poultry industry is being urged by some of the large packing firms to produce chickens that grow faster and pack more meat on their bones, and one large firm has offered $10,000 a year in prizes because they wish to obtain chickens that will weigh over five pounds at the age of 12 weeks. Radiant heating will undoubtedly play an important role in providing ideal conditions for this achievement, for chickens have already been brought to 4½ lb in this time. With the introduction of wingless chickens, following 12 years of experimenting, it is expected that the average chicken weight will be increased considerably above the present standard, with more white meat and heavier drumsticks.

In designing a radiant heating system, care must be taken to ensure that the floor surface temperature is uniform and that no very hot surfaces occur, as this may injure the chicks or cause some biological reaction which will be detrimental to the chicks' development. Furthermore, it is necessary that any control used for the regulation of temperature shall function so that the effect shall be gradual, and that the floor is always warm and dry. Consequently, it does not seem desirable to use any method of control which operates purely on an "on and off" principle, since such a control may allow the floor to become cold during the "off" period and may raise the surface to too high a temperature during the "on" period. This may cause considerable disturbance to the chicks and retard their progress. It is equally important not to control the heat supply by air temperature only, because conditions may arise when the air temperature may be high and the floor cold and damp. Consequently, it is reasonable to assume that an ordinary room thermostat is not suitable for the control. It is easy to accomplish a gradual controlling effect with hot water as a medium, but when using electric conductors in the floor, the gradual controlling of the surface temperature becomes more complicated, unless a resistance control is used.

If the building is designed with a sufficient number of rooms so that the chicks can be transferred from one room to another as they reach the different stages, the method of control is simplified because each room can be maintained at a predetermined temperature throughout the season. If, on the other hand, the chicks are to be reared in one room, then provision must be made to regulate the temperature downwards, according to the age of the chicks, but, at the same time, the floor must be kept reasonably warm and perfectly dry.

Humidity

The question of relative humidity should receive consideration in very dry localities, although it is considerd by some authorities that because of the moisture given off in various ways from the chicks, the relative humidity is usually of a reasonable standard. It is reported by the U. S. Department of Agriculture that for best results when hatching, the relative humidity in the incubator should be maintained at 80 to 90% during the last two or three days before incubation, while the air temperature is maintained at 103F. Since air humidity does materially affect the health and agility of humans, it can be assumed that it affects chicks in somewhat the same manner. The most important phase, however, is a dry floor, which must be achieved if good results are to be expected.

Consequently, since the humidity in the houses will undoubtedly vary according to the outside relative humidity, it may be found in dry climates that

moisture should be added to obtain best results. If the walls and roof are insulated, then a vapor barrier is recommended to prevent condensation at undesirable places. With good insulation and a proper method of ventilation, an ideal controlling system can be safely adopted and successfully operated.

Usually, sufficient heat is given off from the heated floor to maintain the desired air temperature, but this depends on the total exposure losses from walls, ceiling and windows. These losses should be calculated in the usual way, as described in "Radiant Heating",* allowing for the lower total heat losses from buildings usually associated with radiant heat systems. Also, in these cases, some consideration may be given to the fact that the air close to the floor where the small chicks are present, will be slightly warmer than at the higher level. For good results, however, it is desirable not to allow more than the recommended Btu emission per square foot of floor area under the prevailing conditions, although since the temperature of the house is reduced as the chicks become older, the heat emission from the floor for a given surface temperature will be increased according to the formula given in "Radiant Heating".

If too much heat is planned per square foot of floor, it will mean too high a floor temperature, with the consequent ill effect on the chicken due to biological reaction. This writer urges all heating engineers who regard their reputation, to use emission factors which have proved reliable under all conditions of operation. Any supplementary heat required to meet the conditions should be provided for by means of convected heat or heated panels installed in the walls or ceiling. Well insulated walls and roof will invariably make this unnecessary.

Floor Construction

There are many ways of preparing the floor panels, apart from those shown in Fig. 3 and 4. If the building is old, it may be possible to place the pipe coils on existing floors and pour concrete on the top to the desired thickness, probably 2 to 4 inches thick. Some consideration should, of course, be given to the heat loss downwards and an effort made to save on fuel costs. In this respect, it is always advisable to use some insulating material under the pipe coils, which will not be affected by moisture. A layer of vermiculite, 1 inch to 2 inches thick, or other concrete mix with low conductivity placed below the coils will prove most effective in retarding the loss of heat downwards. If the existing floor on which the pipes will be supported is perfectly dry, a layer of celotex or similar insulating material will often prove sufficient, but under no condition must celotex be used if moisture is present. To prevent moisture reaching the pipes and celotex, this writer prefers, in all instances where celotex is applied, to use a waterproof coating between the concrete and the celotex.

A well insulated floor will not only save fuel when the heating is in operation, but it will ensure a warmer surface for the chicks should the heat supply fail.

Fig. 6 illustrates a reliable method of constructing a floor with embedded pipe coils, and in this case it will be noted that the pipe coils are embedded in sand. The sand, of course, is optional, but it is often recommended because it provides freedom of expansion for long lengths of pipes, and it gives a very even surface temperature over the whole of the floor, a condition very essential for chicken rearing. The pipes may be embedded in the concrete, as is often the case with standard designs of floor heating, but since brooder houses sometimes are over 200 ft long, the sand will provide ample expansion freedom for long mains.

*Adlam. T. Napier, *Radiant Heating*, The Industrial Press, New York City.

CONTROLS

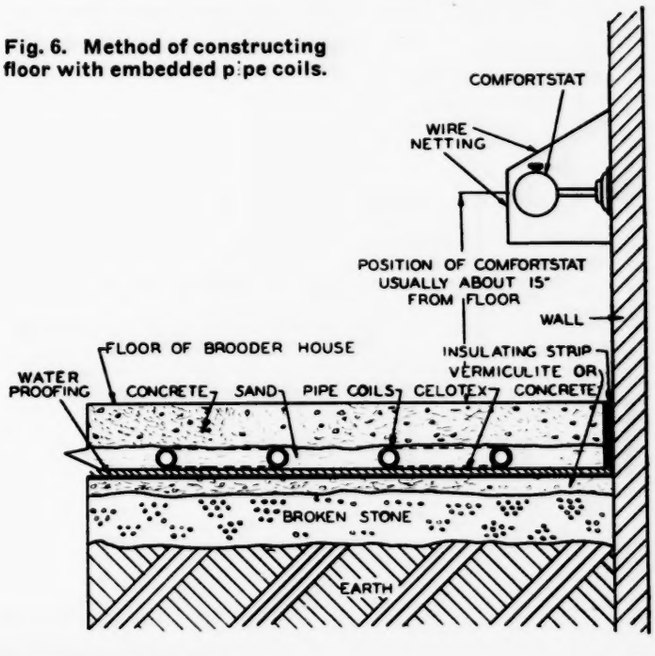
Since it is essential to maintain a warm and dry floor at all times, it is necessary to use a control which will modulate the temperature of the circulating water to maintain steady conditions. To ensure this, it is found desirable to use a control which blends the water to a temperature related to the outside weather conditions, so that there is no abrupt change in floor temperature which could adversely affect the physiological reaction of the chicks.

While there are several very good types available to choose from, Fig. 7 shows a control which not only mixes the water so that the blended temperature is actually related to outside weather conditions, but also makes available a feature to automatically raise the water temperature when necessary to ensure a warm and dry floor regardless of outside weather conditions.

The blending of the circulating water is effected in the usual way, by having an outside thermostat *D* operating in conjunction with a thermostat *A*, over which the blended water flows. An adjustment feature is provided at *K* so that any necessary changes in the blended water temperature can be made after the heating system has been started, to meet the actual heat losses from the building.

Means are also provided to obtain an additional adjustment to alter the gradient of the temperature relation curve shown in Fig. 8. Assuming the calculated relation between the outside air temperature and that of the circulating water is represented by the

Fig. 6. Method of constructing floor with embedded pipe coils.



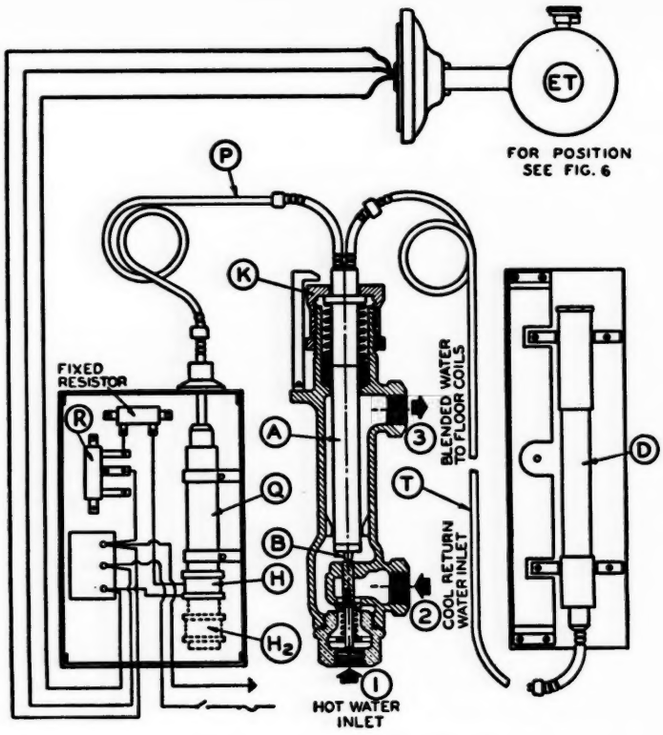


Fig. 7. Control to provide a blended water temperature.

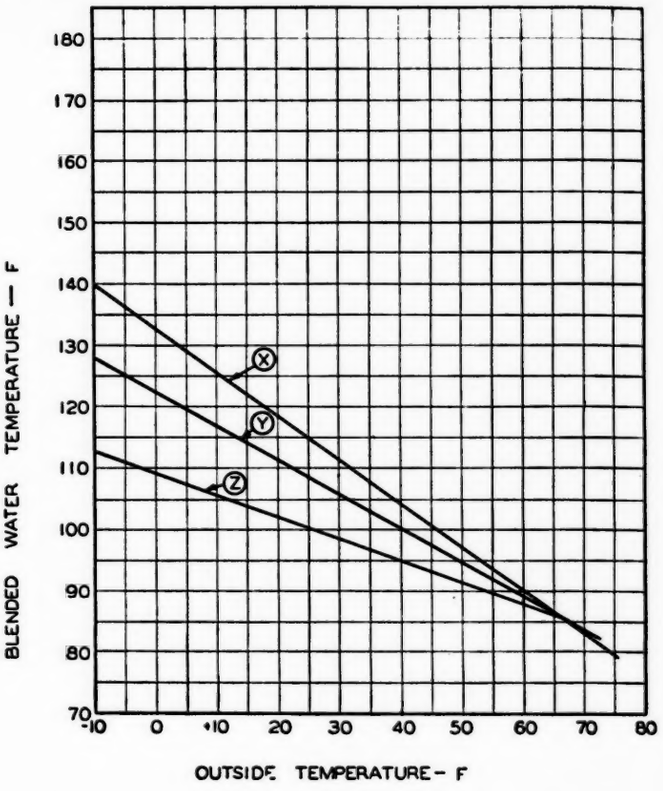


Fig. 8. Relationship of outside temperature to blended water temperature.

curve *X*, it is possible to alter the relation to follow a different curve as indicated by *Y* or *Z*, or any intermediate relation.

For further improvements in the method of control, an auxiliary bulb *Q* is attached to the thermostatic system of the control, to which is fitted an electric heating element *H*, Fig. 7, and this auxiliary unit is housed in a control box with an adjustable resistance *R* to regulate the amount of current passing the heating element *H*. The object of the heating element *H* is to heat and expand the liquid in the auxiliary bulb *Q* when desirable, and thereby affect the movement of the stem *B*. By designing the capacity of the bulb *Q* in relation to the capacities of bulbs *A* and *B*, and regulate the amount of heat given to the bulb *Q* by adjusting the amount of current passing through the heater *H*, it is possible to automatically raise or lower the temperature of the blended water leaving the mixing valve at 3, to any required amount, independent of the outside temperature. The hot water inlet is at 1 and the cool return water inlet at 2.

However, since there may be occasions when solar heat alone will be sufficient to allow the effective temperature of the brooder house to become too high for the chicks, while the actual outside air temperature surrounding the bulb *D* is sufficiently low to call for more heat, it is customary to provide a radiant heat thermostat similar to the comfortstat usually provided in residences for human comfort.

One type of such an instrument, known as the Globe type thermoray, is shown in Fig. 9, and consists of a blackened hollow sphere, inside of which is placed an electric heater *Z*, a thermostat *T*, and an electric switch *E*. The purpose of the heater *Z* is to maintain the outside surface of the sphere at a temperature which, in these cases, corresponds to that of the chicks.

The instrument indicated at *ET*, Fig. 7, is usually installed about 15 inches above the floor so that when the effective temperature due to the radiant heat from

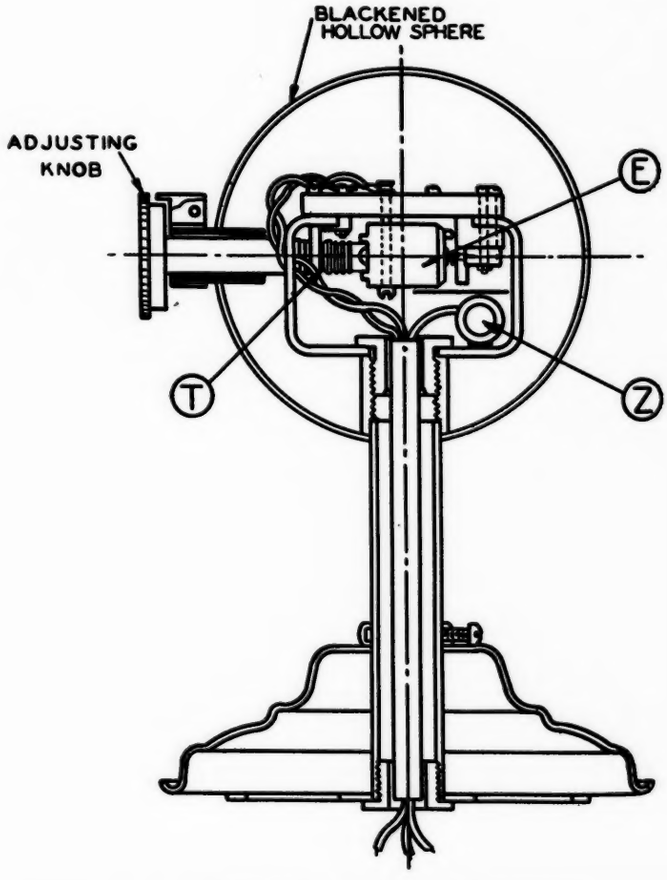


Fig. 9. Details of the Globe type thermoray.

the floor, and the air temperature at this level increases, less heat is given off from the sphere. The result is that the temperature inside the sphere begins to rise and when this reaches the temperature at which the thermostat *T* is set, it closes the switch *E*, and allows current to flow through the heater *H*, Fig. 7, and thereby heat the contents of the auxiliary bulb *Q*. Consequently, when the room conditions become too warm, the current which passes the heater *H*, heats and expands the liquid in bulb *Q*, thereby reducing the temperature of the blended water temporarily until the effective temperature of the brooder house returns to normal. Fig. 6 illustrates how this instrument should be installed in relation to the floor, and how it is usually protected so that the chicks cannot perch on the instrument when they become older.

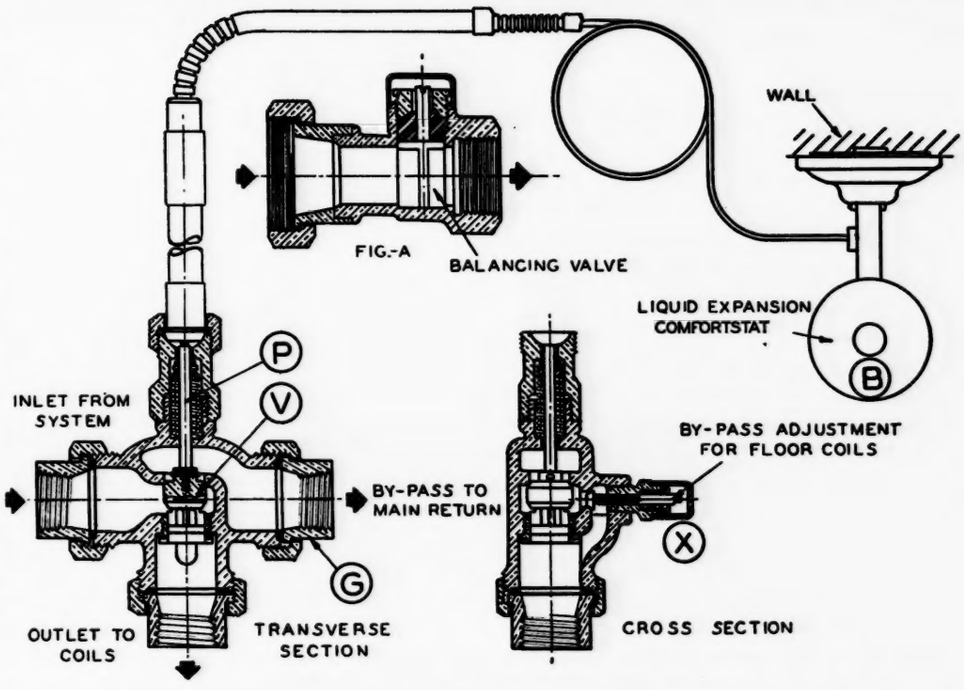


Fig. 11. Auxiliary control to regulate each house individually when using one main weather control for the entire system.

Another method to ensure that the floor is always warm is to place the bulb of a liquid expansion regulator in a tube embedded in the concrete floor, with the capillary tubing from same connected to an electric switch placed on the adjacent wall as near as possible to the thermostatic bulb. The bulb may be placed in any part of the floor, but usually when sufficient depth of concrete is provided, it is placed at right angles to, and above the pipes, or it may be placed a few inches away from one of the embedded pipes forming the heating coil, and near an outside wall.

Providing the concrete in which the bulb is embedded is at a temperature sufficiently high to keep the litter dry (usually about 75F), the electric switch remains closed, allowing a small amount of electricity to flow through a second heater H_2 on the auxiliary bulb *Q*, indicated by dotted lines in Fig. 7. This feature is to apply some heat to the liquid in the bulb *Q* at all times, just sufficient to depress the blended water temperature 10F or thereabout, providing, of course, that the floor temperature is above the minimum required for a dry floor. The control continues to function in the usual way, and maintains the correct water temperature even though the temperature of the bulb *Q* is raised slightly. If, however, the combined effect of the outside temperature on the bulb *D* and the inside effective temperature on the comfortstat depresses the temperature of the blended water below that required for a dry floor, then the heating effect of H_2 is cut out and the blended water is allowed to rise 10 deg and thereby ensure a dry floor. While a 10 deg depression is usually satisfactory, an adjustment is provided so that any other desirable temperature difference may be obtained.

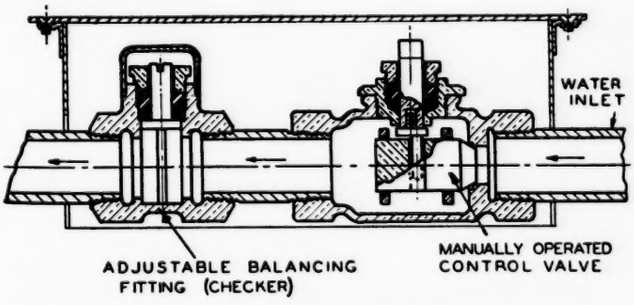


Fig. 10. Valve and balancing fitting in house circuit to maintain each house in a group of houses at different temperatures.

Controlling Several Houses

When it is desirable to have the various houses maintained at different temperatures, but operated from the same main control, it is often found sufficient to have a valve and balancing fitting inserted in either the flow or return circuit to the coils for each house, as used for controlling individual rooms in schools and residences and illustrated in Fig. 10.

If, however, it is desirable to automatically control each house individually, with one main weather controlled unit for the entire system, then, in addition to a control as shown in Fig. 7, it is customary to use a liquid expansion control for each house, somewhat in accordance with Fig. 11. This instrument consists of a three-way valve *V* operated by a liquid expansion system connected to the bulb *B*. The bulb *B* is designed to be very sensitive to changes of effective temperature, and is placed in a position in a similar manner to that described for Fig. 6. As any particular house becomes too warm, the liquid in the bulb *B* expands and the internal pressure thus created will move the valve plunger *P* forward proportional to the increase in effective temperature. The movement of the plunger in this direction tends to close off the hot water flow to the coils and simultaneously opens the by-pass port,

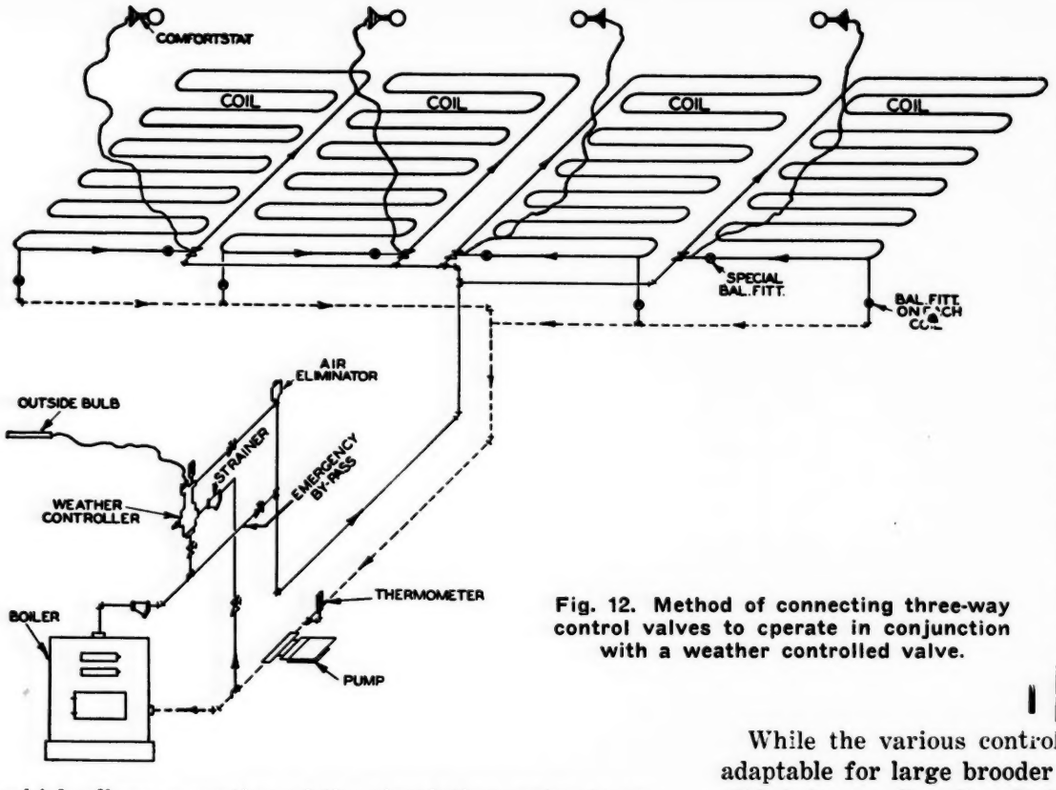


Fig. 12. Method of connecting three-way control valves to cperate in conjunction with a weather controlled valve.

which allows a portion of the circulating water to return to the main system, thus maintaining continuity of circulation. Since the bulb *B* is placed near the floor and is particularly responsive to thermal radiations from the floor surface, it does tend to maintain a warm floor, and functions to prevent overheating.

With this type of control, however, it is customary to have an adjustable by-pass valve at *X* to permit some warm water to pass at all times for the purpose of keeping the floor from getting too cold, should the air temperature alone be sufficient to stop the circulation of the floor coils.

Balancing Fitting

The attachment indicated at Fig. *A* of Fig. 11 is an adjustable balancing fitting which may be fitted into the by-pass at *G*. This, however, is optional. The purpose of this feature is to introduce an artificial resistance in the by-pass equal to the resistance created by the flow of water through the heating coils of any particular circuit. With large and extended systems, this is found very desirable, since it ensures no disturbance of the circulation when a number of the three-way valves are operating simultaneously on the by-passes. This type of control was originally designed to be used in connection with radiant heating systems in large schools. Since the number of pupils occupying a classroom varies so widely, the heat given off by the pupils disturbs the balance of heat, and some provision has to be made to give individual regulation.

To deal with these conditions it is now customary in large schools, to have one or several weather controlled units for zoning purposes, and then to control each classroom separately with a three-way control as shown in Fig. 11.

Fig. 12 illustrates the usual method of connecting these three-way control valves to operate in conjunction with a weather controlled valve.

Instead of using a three-way valve, it is sometimes possible to obtain fairly good results by using an ordinary two-way valve and simply throttle the circulation through the coils. This latter type is usually recommended where the throttling effect in circuits is not likely to cause serious disturbance in the rest of the system. However, since with very young chicks it is essential to maintain some circulation through the coils to ensure a warm and dry floor, a similar by-pass valve should be fitted into the two-way valve, as described and indicated at *X* in Fig. 11.

While the various controls described are especially adaptable for large brooder houses, they may be simplified for small units. It is, however, very desirable to retain the principle of radiant heating for any size brooder house, and equally important to use a control which will keep the floor uniformly dry. Taking into consideration the thousands of chickens reared annually, the saving effected by a reduced mortality; the early development of the chicks; the saving in litter and labor required for attention; and the many other advantages gained, the cost of such a system is now considered a sound investment.

Where electric current is not available, it is customary to use a simple control somewhat as illustrated in Fig. 7, but eliminate the electrical attachments. To control each house and ensure that the floor is maintained at a temperature sufficient to dry the litter, the simple liquid expansion control shown in Fig. 11 may be used.

According to statistics issued by the Bureau of Agricultural Economics, the rate of lay by farm flocks in each month of 1948 has been the highest on record, with the exception of January and February, and it is reasonable to assume that the adoption of radiant heating has helped in this direction. These statistics go on to show that the trend toward an increase rate of lay in all months and in all regions, has been a major factor in maintaining the total egg production in 1948 close to the levels of 1947 despite the smaller number of layers, as shown in Table 1. Undoubtedly, as more brooder houses are equipped with radiant heated floors, the rate per 100 layers per month will become greater.

This means a relatively smaller number of layers to feed to produce the same quantity of eggs. The annual rate of lay per hen and pullet in 1948 was 129 eggs as compared with 127 in 1947. The number of eggs produced in the United States during 1948 totalled about 55,168 million eggs, and at this writing, it is expected that this rate will be maintained throughout 1949.

Estimating Heat Gain from Lights

J. R. JONES[1] and W. B. FOXHALL[2]

Engineers frequently may be required to make heating and air conditioning estimates in the early stages of project planning when information regarding lighting is incomplete. In this article, an attempt is made to evaluate the factors involved in estimating heat gain from lights where actual lighting data are not available.

ROUGH calculation of heat gain from lights, where actual lighting design figures are not available, is complicated by the many variables which will ultimately determine the number of watts (hence heat) used in the space. These variables and their influence on load are as follows:

Level of Illumination — This is measured in footcandles maintained in service at the working level. A footcandle is the illumination at a point on a surface which is one foot from and perpendicular to a point source of one candle. The number of footcandles incident on a surface is equal to the number of lumens divided by the area. A lumen is the light falling on a square-foot section of a sphere of one-foot radius with a one-candlepower source at its center. Hence a one-candlepower light gives off 12.57 lumens. The lumen is used as a measure of source output while the footcandle is a point reading of surface illumination.

The number of footcandles of illumination is directly proportional to the source candlepower and the sine of the angle between the illuminated surface and the incident light ray, and is inversely proportional to the square of the distance from the light source. In general, the higher the level of illumination the higher the lighting load in watts and the higher the resulting heat gain in Btu per hour calculated according to standard practice as watts times 3.414. Footcandle requirements for various applications are listed in lighting handbooks and vary from 0.1 for darkened theaters to 1,000 for surgical operating tables.

System Classification—Lighting systems are classified as direct, semi-direct, general-diffuse, semi-indirect, and indirect. In general, the number of watts required to maintain a given level of illumination increases in the order mentioned. Incandescent lights use approximately 2.5 times as many watts per footcandle delivered as fluorescent lights, depending on the characteristics of the fixture.

Light Utilization—One of the factors in lighting design is the so-called coefficient of utilization. This is the ratio of light reaching the working plane to the total light generated by the lamp. It is a factor that takes into account the efficiency and distribution characteristics of lamps and fixtures, mounting height, room proportions, and the expected reflection factors of walls and ceiling reduced in accordance with anticipated accumulations of dirt on these room surfaces. Coefficients of utilization are tabulated in lighting handbooks and range from near unity down to .03.

Maintenance—The in-service level of illumination, upon which the lighting designer bases his calculations, is the expected average level of illumination. Therefore, he introduces a so-called maintenance factor which takes into account a 10% to 30% loss in lamp output normally expected, plus additional losses brought about by accumulated dirt on lamp and fixture surfaces. Maintenance factors are grouped as good, medium, or poor, depending on expected atmospheric conditions and probable attention to cleaning and replacement of lamps. These factors range from 80% for best to 40% for poorest.

Effect on Heat Gain—The relationship of the variables described to the total heat gain from lamps in a space is shown in an adaptation of one of the basic formulas used in lighting design:

$$\text{Heat Gain in Btu per hr} = \frac{3.414 \times \text{footcandles maintained} \times \text{area illuminated}}{\text{Coefficient of utilization} \times \text{maintenance factor} \times \text{lumens per watt.}}$$

It can be seen that increasing factors in the numerator of the fraction increases the heat gain, while increasing factors in the denominator decreases heat gain.

The lumens per watt factor in this formula refers to the initial rating of the light source, while the footcandles factor refers to the maintained illumination level as described.

Some idea of the variation in lumens emitted per watt of power is offered in Table 1.

A theoretical source of white light of maximum efficiency emitting only visible energy would produce about 200 lumens per watt.

TABLE 1—EFFICIENCIES OF VARIOUS LIGHT SOURCES
(From the Westinghouse Lighting Handbook)

Light Source	Approximate Lumens per Watt
Candle (Luminous Efficiency Equivalent)	0.1
Oil Lamp (Luminous Efficiency Equivalent)	0.3
Original Incandescent Lamp (1879)	1.4
60-watt Carbon Filament Lamp (1905)	4.0
60-watt Coiled Coil Tungsten Filament Lamp (1949)	13.9
500-watt General Service Lamp	19.9
1000-watt General Service Lamp (1949)	21.5
No. 1 Photoflood Lamp (1949)	34.6
400-watt A-H1 Mercury Vapor Lamp (Lamp Only) (1949)	40.0
40-watt White Fluorescent Lamp (Lamp Only) (1949)	62.0

[1]Commercial Engineering Department, Lamp Division, Westinghouse Electric Corp.
[2]Associate Editor, HEATING AND VENTILATING.

TABLE 2—APPROXIMATE HEAT GAIN FROM LIGHTS

Application	Level of Illumination, Foot-candles	FLUORESCENT				INCANDESCENT			
		Class[1]	Low	Avg.	High	Class[1]	Low	Avg.	High
			Btu per (sq ft) (hr)				Btu per (sq ft) (hr)		
Armories	30	A	5.25	6.0	9.0	A	12.0	14.0	19.0
Banks	30	A	5.0	7.0	10.0	A	10.0	15.0	20.0
Barber Shops and Beauty Parlors	50	B	12.0	16.5	24.5	B	20.0	24.0	30.0
Court Rooms	20	B	4.8	6.6	9.8	B	10.0	14.0	22.0
Dance Halls	5	C	1.7	3.7	8.0	B	3.5	7.0	12.0
Drafting Rooms—									
Prolonged Close Work, Art Drafting and Designing in Detail	50	B	10.0	15.0	20.0	C	25.0	40.0	50.0
Hospitals—									
General	50	A	8.0	12.0	18.0	A	25.0	35.0	55.0
Operating Rooms—									
For Major Operations	1000	A	50.0	100.0	150.0	A	100.0	200.0	300.0
For Minor Operations	200	A	20.0	40.0	60.0	A	40.0	80.0	150.0
Hotels—									
Dining Room	5	C	1.7	2.5	4.0	C	3.5	5.0	8.0
Kitchen	20	A	4.0	6.0	8.0	B	15.0	21.0	33.0
Library—									
Reading Room	30	C	9.0	15.0	25.0	C	15.0	35.0	50.0
Office Buildings—									
Bookkeeping, Typing, and Accounting	50	C	12.0	17.0	24.0	C	25.0	35.0	50.0
Post Office—									
Lobby	20	B	4.8	6.6	9.8	B	10.0	14.0	22.0
Sorting, Mailing, and File Room	30	B	7.2	10.0	15.0	B	15.0	21.0	33.0
Professional Offices—									
Waiting Rooms and Consultation Rooms	30	B	6.8	11.0	18.0	B	14.0	20.0	35.0
Restaurants, Lunch Rooms, Cafeterias—									
Dining Areas	10	C	3.4	6.0	10.0	C	7.0	10.0	20.0
Schools—									
Auditoriums	10	C	3.5	5.0	7.0	C	7.0	13.0	20.0
Class and Study Rooms	30	C	9.00	12.0	18.0	C	15.0	21.0	33.0
Store Interiors	40	B	10.0	14.0	18.0	B	20.0	25.0	35.0
Theaters and Motion Picture Houses—									
Auditoriums (Darkened)	0.1	B	.5	.8	1.0	B	1.0	1.4	1.8
Industrial Interiors[2]	30	A	5.0	7.0	9.0	A	12.0	15.0	20.0

[1]A—indicates direct lighting system.

B—indicates semi-direct or general-diffuse lighting system.

C—indicates indirect or semi-indirect lighting system.

The type system has been indicated to allow the heating and ventilating engineer to make an adjustment if he is aware that a different type lighting system is being installed.

[2]General illumination only with industrial RLM lighting fixtures.

NOTE: Fixtures for "low," "average," and "high" values are based on rooms having approximately the following ratios of room width to ceiling height and for recommended footcandle levels for each area:

Low — 6.0 Average — 2.5 High — 1.0

Aside from room shape, room surface reflection factors and the type fixture will cause considerable variation. While an attempt was made to base the values on typical fixtures and room reflectances, it is to be expected that wide variations in Btu's per square foot per hour will occur.

Table compiled by J. R. Jones, Commercial Engineering Department, Lamp Division, Westinghouse Electric Corp.

In fluorescent or mercury lamp installations the wattage of ballasts or transformers must be added to that of the lamps for air conditioning calculations. Ballast loads for fluorescent lights range from 7.5 to 22 watts per lamp, depending on the fixture and voltage used. Comparable mercury light ballasts are rated at 40 watts for the widely used 400-watt lamp. Inclusion of loss for the most frequently used ballasts lowers tabulated values to approximately 36 lumens per watt for the mercury lamp and to 51 lumens per watt for the 40-watt fluorescent lamp.

How to Make Estimates

All of the foregoing would seem to indicate that there are just too many variables involved to warrant any sort of lighting load estimate prior to actual lighting design; and, in fact, the lighting design factors have been described expressly to inject that note of caution. Fortunately, however, design practice and space characteristics fall into general categories of use and occupancy which suggest that typical conditions and dimensions may be selected for various types

of enclosures and hence expected loads calculated for the range of standard practice in lighting design.

For instance, present day practice for general office space for bookkeeping, typing, and accounting departments tends to large, light-painted space maintained at about 50 footcandles of illumination with indirect or semi-indirect fluorescent lighting under medium to good maintenance conditions. For expected average conditions in such space the load would be about 5 watts, or 17 to 19 Btu per (hr) (sq ft). If the room were smaller than average with respect to its height, the load per square foot of floor space would be correspondingly higher. The converse, of course, is also true. Use of incandescent fixtures for the same class of lighting would approximately double the load per square foot. Exceptional influence of any of the variables described would also have an effect on the average figure.

It is reasonable to assume that similar averages could be worked out for other types of space. This has been done for heating and air conditioning estimates and the resulting data are presented in Table 2. Here recommended illumination levels, class of system, and type of fixture usually used in the applications listed are the basis for calculating low, average, and high values of heat gain from lighting, according to combinations of variables favorable, average, or unfavorable, respectively, toward what might be called lighting effectiveness.

This table was compiled by J. R. Jones of the Commercial Engineering Department, Westinghouse Lamp Division, who includes a cautioning footnote regarding the variables previously discussed.

Other Classes

For classes of lighting system and corresponding types of fixtures other than those indicated in Table 2, a guide to adjustment of the given values is suggested in Fig. 1, adapted from the Westinghouse Lighting Handbook. The curves in this figure were drawn for very rough estimates of load in average size rooms and serve best for comparative purposes only. Thus, if the commercial-indirect fluorescent lighting system (Class C) previously cited for office space and shown in Table 2 to have an average heat gain of 17 Btu per (sq ft) (hr) is converted to a commercial-direct (Class A) fluorescent system, readings from the corresponding curves in Fig. 1 at the 50-footcandle level indicate that a conversion factor of 10.5/19 or .55 should be applied. The resulting average heat gain for offices with 50 footcandles of Class A fluorescent lighting is found to be 9.4 Btu per (sq ft) (hr).

This factor can be applied to the low, medium, and high values for fluorescent lighting of office buildings as shown in Table 2, but, of course, for incandescent systems other curves in Fig. 1 would be used in calculating the conversion factor.

Direct reading of values given in Fig. 1 will not be as accurate as the conversion process described, be-

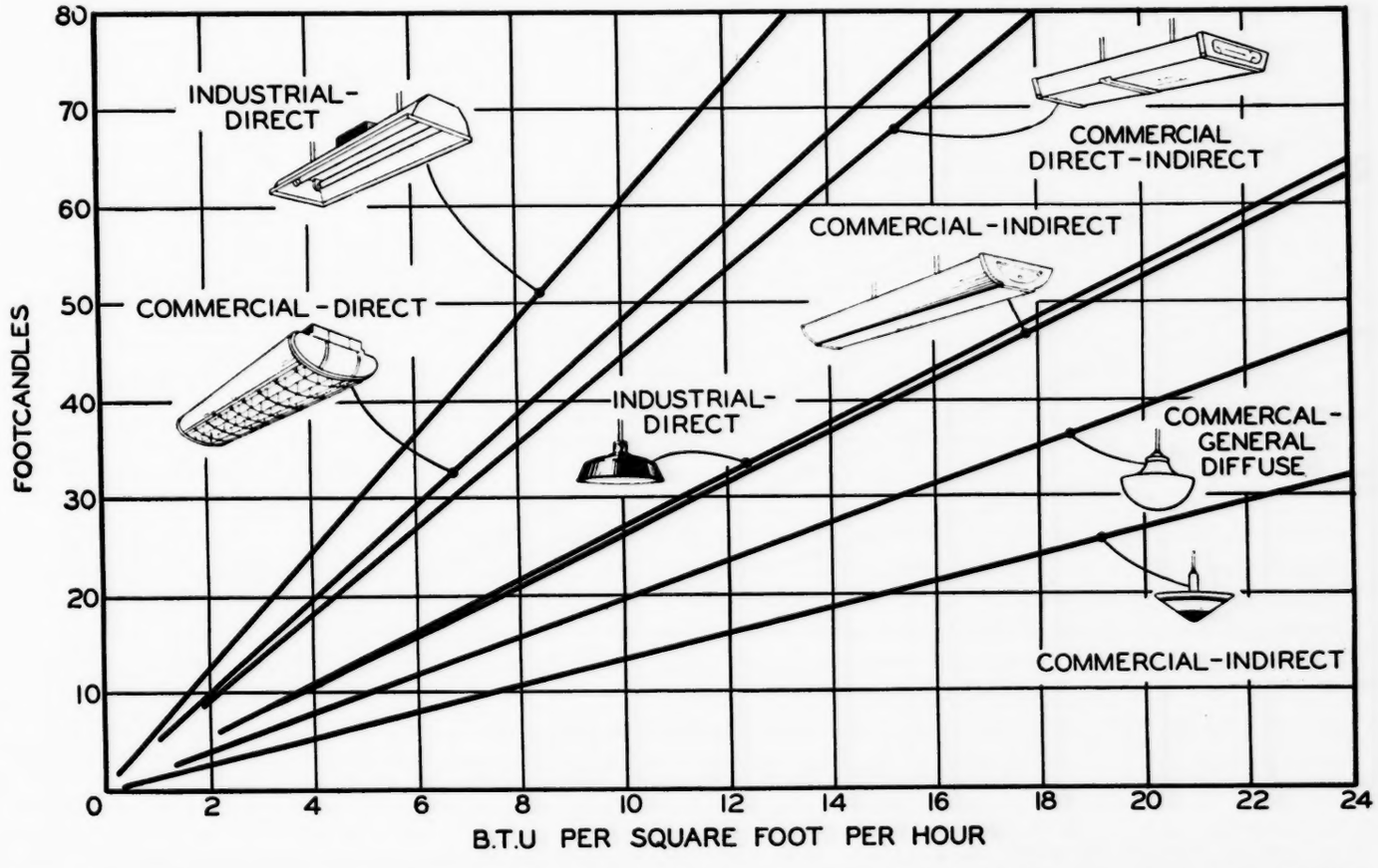


Fig. 1. Average heat gain from lights where no data regarding type of space is available. These averages are extremely broad and are suitable for only the roughest estimations. Fluorescent and incandescent lights are indicated by the types of fixtures drawn, and classes of lighting, as shown in Table 2, are marked above as follows: Class A—industrial-direct, commercial-direct; Class B—commercial-direct-indirect, commercial-general-diffuse; Class C—commercial-indirect.

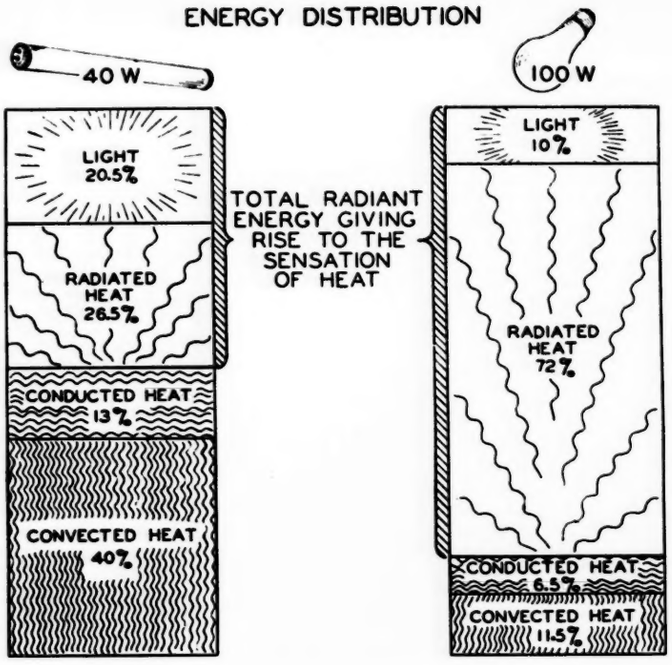


Fig. 2. Energy distribution for 40-watt fluorescent and 100-watt incandescent lamps. Each has approximately the same lumen output.

cause Mr. Jones has introduced special average values for design factors typical of the applications listed in Table 2.

Example

An example of how Fig. 1 and Table 2 might serve the air conditioning engineer in preliminary estimates is as follows:

Assume the dining area of a restaurant is to be air conditioned and the engineer has access to only a general floor plan. Table 2 shows that, for this application, about 10 footcandles of indirect or semi-indirect (Class C) lighting are to be expected.

Assuming a fluorescent system, Table 2 shows that in a long, narrow, high ceilinged room (where the coefficient of light utilization and maintenance factor are low) a "high" heat gain of about 10 Btu per (hr) (sq ft) can be expected.

In a more nearly square room with a correspondingly higher ratio of width to ceiling height and where higher proportions of light-painted ceiling areas are expected (hence a higher coefficient of light utilization), a "low" lighting load of about 3.4 Btu per (hr) (sq ft) can be expected.

Intermediate values can be estimated within the scope of the engineer's judgment, and an "average" value of about 6.0 Btu per (hr) (sq ft) is suggested for indirect or semi-indirect fluorescent systems maintaining 10 footcandles of illumination.

Other Classifications

Corresponding figures are given in Table 2 for indirect or semi-indirect incandescent systems in this application. (Note that in certain applications, such as drafting rooms or dance halls, general practice would be to use a fluorescent system different in classification from an incandescent system in the same application.)

If the estimator has information leading him to expect the restaurant under discussion to be lighted by semi-direct (Class B) fluorescent lighting rather than the indirect (Class C) system for which data are given in the table, he can calculate the heat gain by deriving a conversion factor from Fig. 1 for application to tabulated data. The curve in Fig. 1 for commercial-indirect (Class C) fluorescent lighting crosses the 10-footcandle abscissa at about 3.8 Btu per (hr) (sq ft); and the curve for commercial direct-indirect (Class B) fluorescent lighting crosses the 10-footcandle level at about 2.3 Btu per (hr) (sq ft). The factor for conversion from Class C to Class B fluorescent lighting, then, will be 2.3/3.8 or .6, and the low, average, and high heat gain figures will be 2.0, 3.6, and 6.0 Btu per (hr) (sq ft), respectively, for fluorescent lighting.

Similarly, if it is known that a general-diffuse (Class B) incandescent system will be used, Fig. 1 shows the ratio of conversion between the commercial-general diffuse (Class B) and commercial-indirect (Class C) curves to be .68 and the resulting low, average, and high loads for Class B incandescent lighting will be 4.8, 6.8, and 13.6 Btu per (hr) (sq ft), respectively.

Note that, since curves in Fig. 1 are straight lines, conversion factors may be calculated at any convenient footcandle level on the chart.

Where the Heat Goes

There is an interesting contrast between fluorescent and incandescent lighting in the radiated heat component of the engery used by the lamps. Two lamps of comparable initial lumen output, such as the 100-watt incandescent and the 40-watt daylight fluorescent, show energy distribution as indicated in Fig. 2, where 72% of the energy consumed by the incandescent lamp appears as radiated heat, while 26.5% is the corresponding figure for the fluorescent lamp.

In the calculation of total heat gain, of course, total watts consumed is the only figure involved. However, H. E. Ziel of Albert Kahn Associated Architects and Engineers points out in an article in the June, 1948, issue of HEATING AND VENTILATING that, in zoning for heat gains from lighting in a multi-story building, the lighting gain on each floor is released in a manner to supplement gains on the floor above almost entirely. This is attributed to the fact that heat from lights tends to warm the ceiling of the lighted room and is hence transferred by conduction through the structure and convection through stair openings to the floor above.

A basis for estimating how much of the heat gain from lights remains as a gain on the floor where it originates is suggested by Fig. 2.

Assuming that 50% of the radiant energy (both radiated heat and light) from the lamps serves to warm the air, occupants, and surfaces of the lower half of the room (and is therefore a gain in the room of origin), it appears from Fig. 2 that .50 $\times$ .84 or 41% of the total heat gain from incandescent lighting remains on the floor of origin in multi-story buildings, while the corresponding fraction for fluorescent lighting is 23.5%.

Spot Heating with Unit Heaters

H. E. SMITH
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Where localized heat is required, unit heaters offer a flexible, economical means of providing it. Precautions and rating procedures outlined in this article offers a practical basis for design.

SPOT heating . . . the heating of a relatively small, unenclosed area or volume within a much larger enclosed or partially enclosed space, is seldom entirely successful. It is a pitfall which has meant trouble to many heating engineers and contractors. This is undoubtedly true because results are usually unpredictable, and because there is an almost total lack of design data available based on either experience or theory. This lack is understandable because no authority has cared to sanction rules or suggestions for the design of a heating system which, at best, is a substitute, and which is frequently adversely affected by unexpected local conditions.

Yet the designer cannot ignore the fact that in spite of its shortcomings, spot heating is often necessary. It is often the only solution to a problem that must be solved.

The necessity of supplying heat to the operator of a sawmill; to the operator of a punch press or shear in an unheatable steel warehouse; or to an internal combustion engine intermittently operated in extremely cold weather, are typical examples.

In such cases the use of the light-weight, suspended, propeller-type unit heater is often a good practical answer. This product lends itself very well to the solution of most spot heating problems at reasonable cost. It is available as a standard product in several styles and many sizes for a wide range of steam pressures. First cost, installation cost, and operating expense are reasonable and it can easily be moved or relocated. Even more important, it is compact and easily controlled. Any discussion of spot heating must, therefore, deal with the selection and application of unit heaters.

Any such discussion must be predicated on two basic rules which will invariably apply to any spot heating job regardless of its individual peculiarities. These two rules, precautionary in nature, must always be kept foremost in the mind of the designer.

(1) Extreme caution must be used in making performance predictions. It is folly, for example, to promise or attempt to get a draftless 60 or 70F temperature for an isolated spot in an open building subject to zero weather. Be explicit in pointing out the difficulties and the complicating factors involved.

(2) Completely disregard unit heater manufacturers' published data concerning heat-throw and mounting height. Those data are necessarily based on normal complete heating in a reasonably well enclosed structure. They cannot be used to estimate performance in spot heating applications.

Arrow points to unit heater installed in a section of a warehouse set aside as an assembly bay.

Design suggestions supplementary to these two cardinal rules may be given but they must be used conservatively bearing in mind that they are the result of actual observation and trial and error, rather than of prolonged technical observation and testing under laboratory conditions.

Spot heating installations fall broadly into two categories . . . stationary and portable.

Portable installations may be fairly complex mechanically but they are usually relatively simple to design because they are inherently simple to adjust. For example, spot heating equipment to thaw and dry railway switches or car running gear; to preheat aircraft engines; or to temporarily heat box cars during loading may well involve a unit heater mounted on a truck or trailer and supplied with steam through a flexible hose or from a small truck-mounted steam generator. In such systems, the unit heater can usually be placed extremely close to the spot to be heated and the heated air can further be localized by special discharge nozzles or by restraining tarpaulins.

Much more difficult to design and therefore meriting more detailed discussion, is the more commonly encountered stationary spot heating system, usually involving the supplying of heat for the operator of a solitary machine or localized process within a much larger unheated building.

Both vertical and horizontal discharge unit heaters may be used in such applications, the decision being

governed by the shape and physical peculiarities of the space to be heated, the location of available steam facilities, and the presence of physical obstructions. The presence of a low overhead conveyor system might dictate the use of a vertical delivery unit, but a traveling crane at a considerable height might make a horizontal delivery unit necessary... possibly installed at or near the floor level, since spot heating can seldom be done satisfactorily from an extreme height. A symmetrical square or circular area might indicate a vertical delivery unit, while a long, narrow rectangular or oval area might justify selection of one or more horizontal delivery units.

In making this preliminary survey, it is essential to drastically restrict the mounting height of the unit or units. Heat losses, as they are usually considered in a normal heating problem, are meaningless in a spot heating application. The objective is to blanket the prescribed space with a constant stream of warmed air. Obviously, then, the volume of this imaginary three dimensional space to be heated must be restricted as much as possible. Since the height of that space is fully as important as its length and width (or diameter), the unit heater must be kept as low as possible. Even more important, however, is the fact that the warmed air discharged from the unit must penetrate extremely cold air. Because of the great temperature difference between the warm air and cold air and because there are no supplementary heating units in the adjacent unheated spaces to set up "helping" air currents, the heated air is extremely buoyant. It tends literally to "bounce" up to the ceiling where it is not wanted. Fan equipment that is practical from an economic standpoint simply will not project the heated air to any great distance under such conditions. The heat throw or permissible mounting of any unit heater will probably be less than half of the distance suggested by the unit heater manufacturer for normal heating installations.

In cases where piping problems require the unit to be placed at an excessive height, it is sometimes feasible to provide a straight duct from the discharge of a vertical delivery unit to a more reasonable height. An adjustable diffuser can be provided at the outlet end of the duct if it is deemed advisable.

The fact has already been established that the dimensions of the space to be heated and the maintenance of a constant flow of heated air are vitally important. Also of great importance is the temperature of the air discharged by the unit heater and its velocity.

The length and width, or diameter, of the space to be heated must be determined very closely. Partially confining walls such as a low partition, even if only two or three feet in height, are extremely helpful since they minimize the tendency of cold drafts to flow along the floor from the unheated section into the space to be heated. Similarly, a ceiling or canopy . . . partial or complete and as low as possible . . . is of real value since it restricts the tendency of the heated air to rise rapidly to the unheated ceiling spaces. This, of course, is particularly desirable in high ceilinged rooms. The value of these features is sufficiently great to justify a real effort by the designer to provide them.

Where such retaining walls are provided, the length and width of the space to be spot heated may be considered as being the dimensions of the walled-in space. Where such walls are not possible, these dimensions should be the length (or width) of the space to be heated plus ten feet.

Where a restraining canopy is possible, the height may be taken as the actual height to the canopy. Where such a ceiling is not practical, the height of heated space should be considered as being heater mounting height plus 50% but plus at least six feet, unless the resulting figure exceeds the actual ceiling height of the building in which case the latter will apply.

Having obtained these three dimensions, the volume should be determined and a unit heater (or heaters) should be selected having desirable final air temperatures and outlet velocity characteristics and which will provide from 15 to 30 air changes per hour by using the formula

$$CFM = \frac{Vol. \times AC}{60}$$

where: CFM = Air delivery, capacity of unit heater in cubic feet per minute (catalogued rating)

Vol. = volume of space to be heated
AC = number of air changes per hour
60 = minutes per hour

Judgment must be used in estimating the required number of air changes per hour since it is impossible to set up universally applicable formulae. The maximum of 30 air changes should always be used where the large building is so poorly constructed as to be little more than a windbreak; for small areas of less than about 250 sq ft of floor area; for areas near often-opened doors; and for larger areas which are exposed (not adjacent to restraining walls) on all four sides or which are long and narrow or otherwise shaped so as to present a comparatively large perimeter for the escape of the heated air. Conversely, the number of air changes may be safely reduced for larger spaces enclosed on one or two sides by the building walls and for large, compact areas which represent a fairly great percentage of a reasonably tight and well constructed building.

Care must be used to select unit heaters having a good final air temperature under the anticipated operating conditions of steam pressure (or water temperature) and entering air temperature which is assumed to be the lowest probable temperature of the unheated space. These characteristics can usually be obtained from the manufacturer's catalog. The final air temperature under these design conditions should be the entering air temperature plus about 65 degrees but not less than 90 degrees. This requirement may dictate the use of low outlet temperature units, particularly if high pressure steam is used.

The velocity of the air leaving the unit heater is also important though the allowable limits are extremely difficult to define and considerable judgment must be used for each individual installation. Unavoidable errors in judgment may often be minimized or cor-

rected by the use of an adjustable diffuser if the error has been made in selecting a unit with too much velocity. Obviously, little can be done if units having a velocity which is too low are selected. In general, when overhead *horizontal* delivery units are used at limited heights of not more than 7 or 9 ft, outlet velocities should range from 850 or 900 fpm for small units of about 1,300 cfm to 1,200 or 1,400 fpm for larger units of about 4,000 cfm. When vertical delivery units are used, velocities should range from 950 or 1,000 fpm for 1,500 cfm units to around 1,900 fpm for 8,000 cfm units.

The importance of maintaining low mounting heights has already been discussed. Here, again, it is difficult to prescribe definite limits but, in general, horizontal delivery units should never be mounted more than 7 to 9 ft high unless they are very large . . . exceeding 5,500 cfm and 1,700 fpm. Vertical delivery units should be limited to a maximum of 10 ft unless they are very large (exceeding about 6,000 cfm) in which case they may set as high as 20 ft.

These suggestions outline the simplest type of spot heating system but in many cases it is practical to incorporate added refinements which will add greatly to efficiency and performance of the installation.

Recirculating ducts with either horizontal or vertical delivery units to draw the inlet air from the floor area of the heated space should be used wherever they are physically possible. This will permit use of a design entering air temperature at least 20F above the normal room temperature of the surrounding unheated space and it will reduce the design number of air changes per hour by 25%. In such cases the ductwork should be approximately full size of the unit heater inlet with a minimum of bends and other restrictions. Inlet openings instead of grilles should be used in order to minimize the static loss.

Another refinement which is often practical and always efficient is the use of unit heaters discharging horizontally just above the floor into the space to be heated. If this is done, lower outlet velocities are desirable and several small units should be used in preference to one large unit. A similar system, equally good but not always practical because of construction difficulties, involves a unit discharging vertically upward through a grille or grilles in the floor below the operator's feet. This might dictate a horizontal delivery unit taking its inlet air through a duct from the outside of the heated space and discharging upwards in the center of the space. An inverted vertical delivery unit under the floor can be used but it is difficult to prevent dirt and debris from falling into the unit through the floor grille. Here, again, lower velocities and small units should be used and outlet temperatures should be low. In both of these suggested arrangements, particularly if the heated space is fairly large, the units may well be supplemented by overhead verticals to confine the heated air within the prescribed zone.

If no other purpose is served, this review should emphasize the fact that any solution to the spot heating problem is difficult and unorthodox. At the same time a solution is possible. Careful evaluation plus a full realization of the hazards involved can result in an installation which will be highly satisfactory and a credit to the designing engineer or contractor and to his profession.

Performance of Stokers Improved by Baffles

The use of ignition baffles or refractory arches is one of the simplest and most effective means of improving the performance of single retort stokers, The American Society of Mechanical Engineers and the American Institute of Mining and Metallurgical Engineers were told at their joint 12th annual Fuels Conference at French Lick, Ind., October 27. One of the outstanding advantages of these baffles is the fact that they may be used with either existing or new installations, it was declared. Also participating in the meeting was the Indiana Coal Preparation and Utilization Society.

Research with this equipment was conducted at the Coal Combustion Laboratory, Pennsylvania State College, State College, Pa., by T. S. Spicer, associate professor of fuel technology and supervisor of the Laboratory; C. C. Wright, professor and head of the division of fuel technology, and R. J. Grace, assistant professor of fuel technology. They said the use of the baffle in one of the twin 178-hp fire-tube boiler units at the college's Nittany Dormitory heating plant during the 1948-49 heating season showed the following advantages:

(1) Elimination of the black fuel bed over the retort.
(2) Increase in the output of the stoker boiler unit by 40 to 50%.
(3) Reduction of manual labor to a minimum.
(4) Elimination of the periodic smoke discharge resulting from disturbing the bed.
(5) Increase of combustion efficiency. The CO_2 content of combustion products was increased several percent because less excess air was required.
(6) Increase of boiler efficiency by 4.0% although burning at higher rates. The temperature of the boiler exit gases remained practically the same.
(7) Fly-ash and carryover to boiler tubes was less.

The flat refractory baffles are located directly over the center of the retort and extend from the front wall to the bridge wall. They may be suspended at a height of 19 to 27 inches above the level of the firebars depending upon the size of the machine. The width of the baffle represents approximately 50% of the inside firebox width. The baffle may be four to six inches thick and is supported by two-inch pipes which are cooled by circulating water from the feedwater pump. Makeup water may also be used to cool these units or the supporting units may be directly connected to the circulation of the boiler water. The refractory part of the baffle is made from a castable material such as Plicast No. 30 or equivalent. Pre-fired refractory shapes may also be used.

When It's Time To Go Home

T. W. REYNOLDS
Chief, Air Conditioning Division, Abbott, Merkt & Co., New York

WHEN it's too hot for comfort and your employees have you under observation as just another Simon Legree, you have to decide whether to close the office for the rest of the afternoon and let them all go home, where it may or may not be cooler, or even go on a Roman holiday to other places where it may be much hotter than the office. Upon what basis, then, intelligent or otherwise, will the decision be made?

The writer, in the past, always felt it was time to call it quits when the papers on the desk clung to his bare arms. Others have rules of various kinds. For example, a large insurance company rules that 92F and above calls for office closure. Of course, much depends upon the particular office, its effective temperature, how well it is cross ventilated, whether located below a roof, and whether the roof is insulated. Indoor conditions should be considered rather than those outdoors. In the final analysis, bearing in mind that time is money and that comfort promotes efficiency, would it not be cheaper to air condition and stay put?

When the effect of humidity on comfort and efficiency is considered, the rule for closing at 92F D.B. will, upon occasion, close the office (see chart) on days that are not too uncomfortable and keep it open on other days that are far too humid for comfort. Nor will wet bulb temperatures alone be an accurate guide for closure. A more sensible rule is to use an outdoor effective temperature of 81F at still air conditions as a maximum working environment.

Since psychrometric charts and the concept of effective temperature are not familiar tools of the average office manager, an empirical relationship has been worked out making use of dry bulb and relative humidity readings which he can get by telephone from his local weather bureau. The resulting rule is that the office should be closed when the sum of the dry bulb temperature plus 20% of the percent relative humidity exceeds 100. Don't ask the wherefore of the 20% or the figure 100. It just works out that way.

The accompanying graph shows that the curve for this sum during July and August, 1949, follows closely parallel to the curve for effective temperature and indicates closing the office on the same days. These two rules, at least for the given graph conditions, are not so far off from the simple dry bulb rule, providing the maximum dry bulb limit is fixed at 90F.

Example: On July 20, 1949, noon readings in New York were 88.6F D.B. and 65% R.H. Under the simple dry bulb rule the office would remain open. However, the effective temperature at this dry bulb temperature

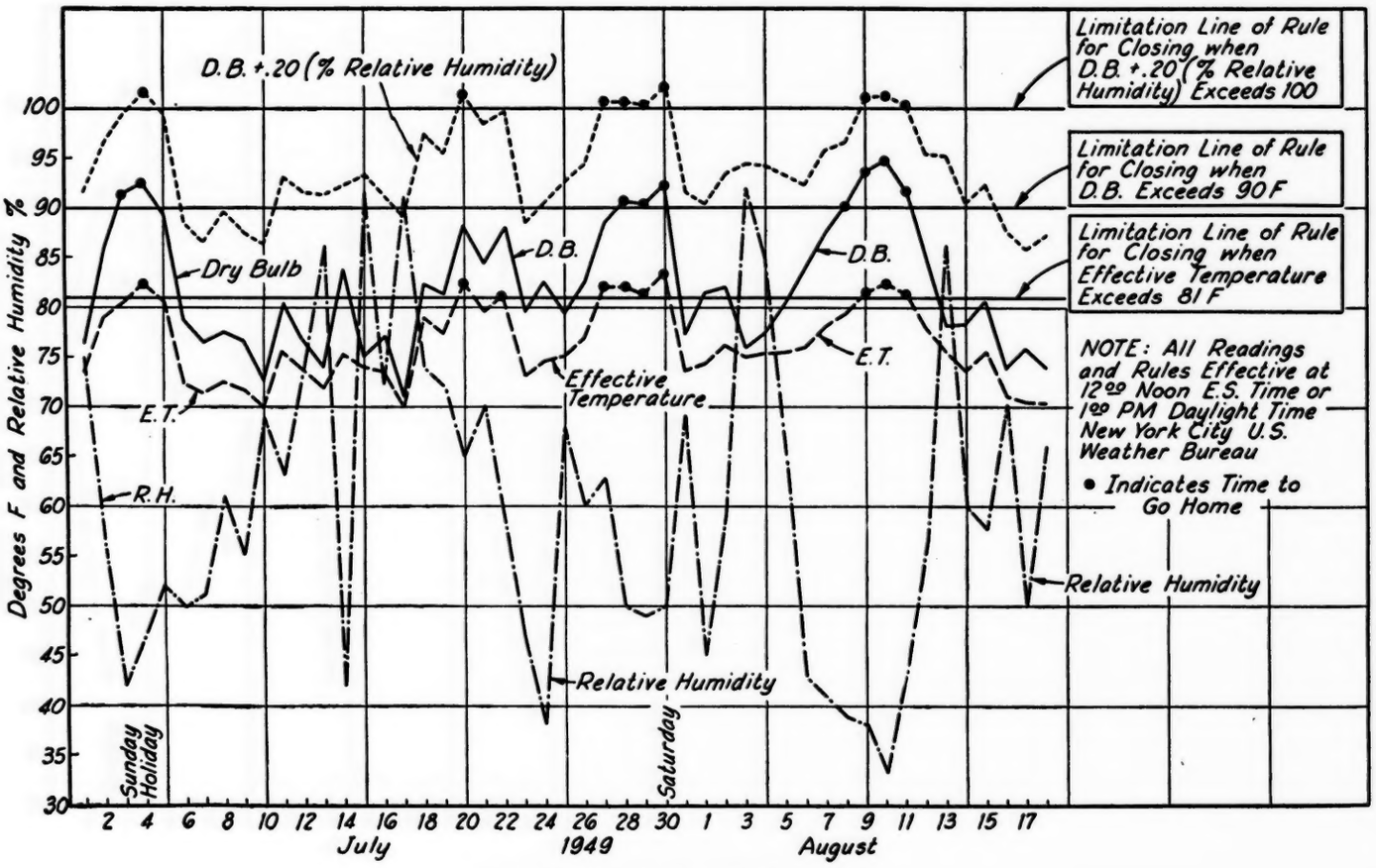


Chart showing time to go home.

and humidity and in still air would be 82.8F, indicating an uncomfortably humid day, and the office would close under the effective temperature rule.

The empirical rule shows that

$$D.B. + .20\ (\%\ R.H.) = 88.6 + .20\ (65) = 101.6$$

Since this is greater than 100, the office would close under this rule also.

At this point one might well ask upon what basis the effective temperature is fixed at 81F. The answer is that this is the point where the writer felt too uncomfortable, and he believes that he is a fairly average fellow in this respect. Localities other than New York may give different findings in extreme cases but a few trial casts for other localities did not indicate wide differences. In any event, it will be seen that as the dry bulb goes up the relative humidity as a general rule goes down.

The graph for this unusually hot summer shows that your office would be closed in the afternoon on the basis of noon readings (Eastern Standard Time) on seven of the same working days for two of the rules and six working days for the dry bulb rule. Closure on five of these days was indicated under all three rules.

Incidentally, the various limitations may be raised slightly if the weather bureau records are taken a couple of hours later, particularly so for the D.B. rule. However, the given limitations have been lowered slightly to take account of later conditions.

Building Codes and Construction in the United States

The housing shortage in the United States has focused attention on two problems relating to building codes: first, the present status of building codes and, second, the relation of existing codes to the rate of construction. There have been many discussions of these two problems in recent years, but data have not been available as to the actual status of the codes themselves, while the problem of codes and their relation to housing has been over-simplified.

The present status of building codes has been studied by the Building Technology Division of the National Bureau of Standards. Analysis of the data reveals that: (1) most of the codes have not been overhauled for some time; (2) a considerable fraction of municipalities in the United States have no type of building regulation; and (3) over 200 municipalities are completely revising their codes, indicating appreciation of engineering advances in building construction.

The facts disclosed by the Bureau survey confirm the general impression that a considerable number of codes have not had a major overhauling for some time. When arranged according to the dates attributed to them by local authorities, codes now in effect can be classified into the six groups in Table 1.

TABLE 1—AGE OF DATED CODES

Age Group	Number of Cities	Percentage
Up to 5 years	574	27
6 to 10 years	366	17
11 to 15 years	244	11
16 to 20 years	377	18
21 to 25 years	327	15
Over 25 years	264	12
Total	2,152	100

The data on age of codes may be subject to some error, first, because there is uncertainty as to some dates and, second, because amendments in some cases have the effect of modernizing a code without leading to a change of date. These factors, however, are not sufficiently significant to affect the above summaries in any appreciable way.

It is significant that 29% of the municipalities have no type of building regulation. Some municipalities do not have codes but do have rudimentary ordinances requiring permits in order to do building or setting geographical limits within which some types of combustible construction may not be erected. Information of this kind is summarized in Table 2.

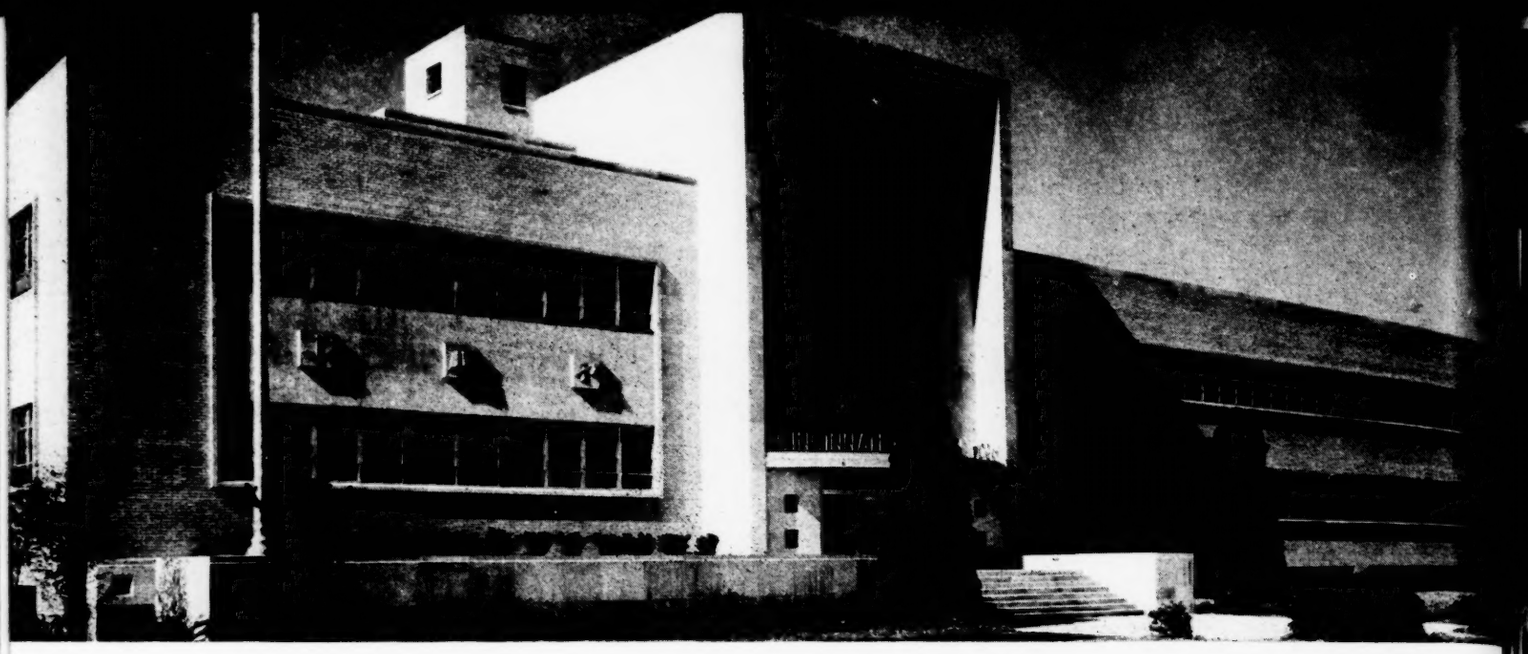
TABLE 2—DATA ON MUNICIPALITIES WITHOUT CODES OR DATED CODES

Code Information	Number of Municipalities
No Code	990
Permit Ordinance	183
Fire Limits Ordinance	164
State Regulations Adopted	37
No Code Age Given	47
No Report on Code Status	67

The absence of codes in such municipalities suggests that in these areas new materials, construction methods, and designs may be used. To a limited extent this is true, and some of these regions have served as proving grounds for new developments. On the other hand, the absence of codes represents a real hazard to the public safety.

The data for the entire country are of considerable interest. They show that 71% of municipalities have some sort of regulation. Building codes are, however, essentially an exercise of state authority. The actual requirements are generally local in character by virtue of a delegation of the state power to municipalities through charter provisions or enabling acts, but the power itself is of state origin.

Here again some qualification is necessary, for many states have miscellaneous legislation applying to certain buildings throughout the state and others have state building codes. The figures for Wisconsin indicate that only 60% of the municipalities have codes, but there is a state building code in effect covering all but one- and two-family dwellings. Thus, the fact that a municipality does not have a code does not necessarily mean that it is altogether without building regulation although in many cases this is so.—E. U. CONDON, Director, National Bureau of Standards.



New headquarters of Cincinnati Chemical Works, Inc., containing a total of 67,000 sq ft.

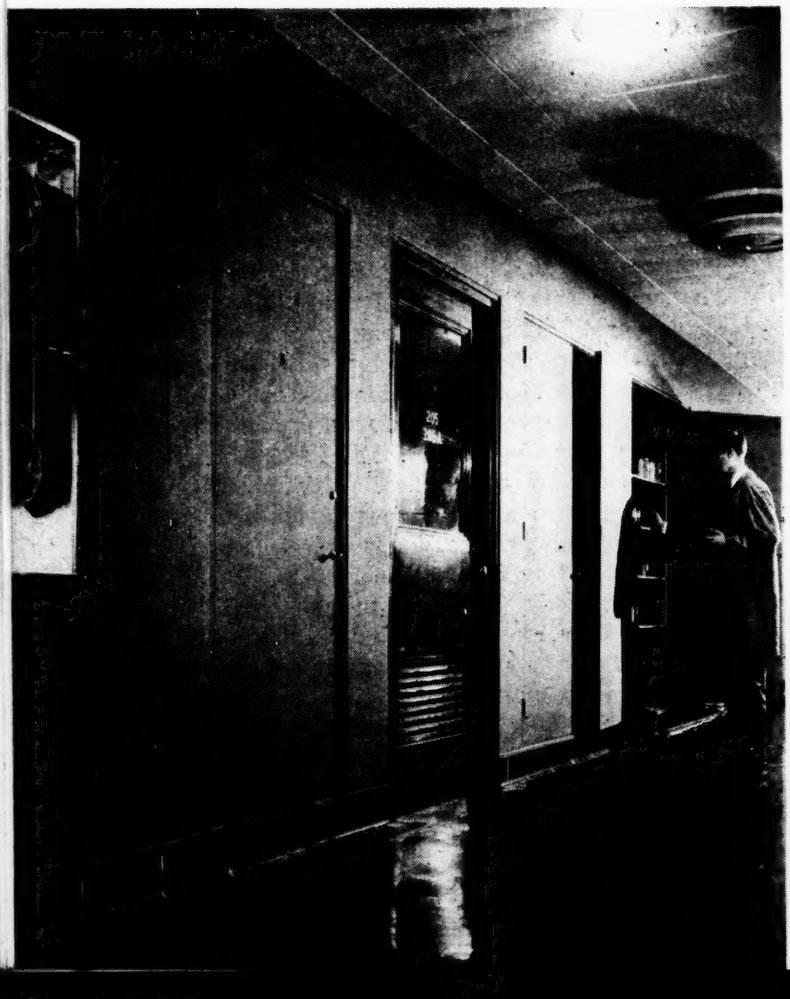
Air Conditioned Chemical Plant

THE executive and business offices and product development activities of the Cincinnati Chemical Works, Inc. have been transferred to the new two-story and basement administration and research center recently completed on Laidlaw Avenue, Bond Hill, Cincinnati.

Designed and built by The Austin Company to provide a maximum of convenience and flexibility for applied chemical research and general business functions of this growing organization, the 67,000 sq ft structure incorporates an unusual combination of form, texture, color and light.

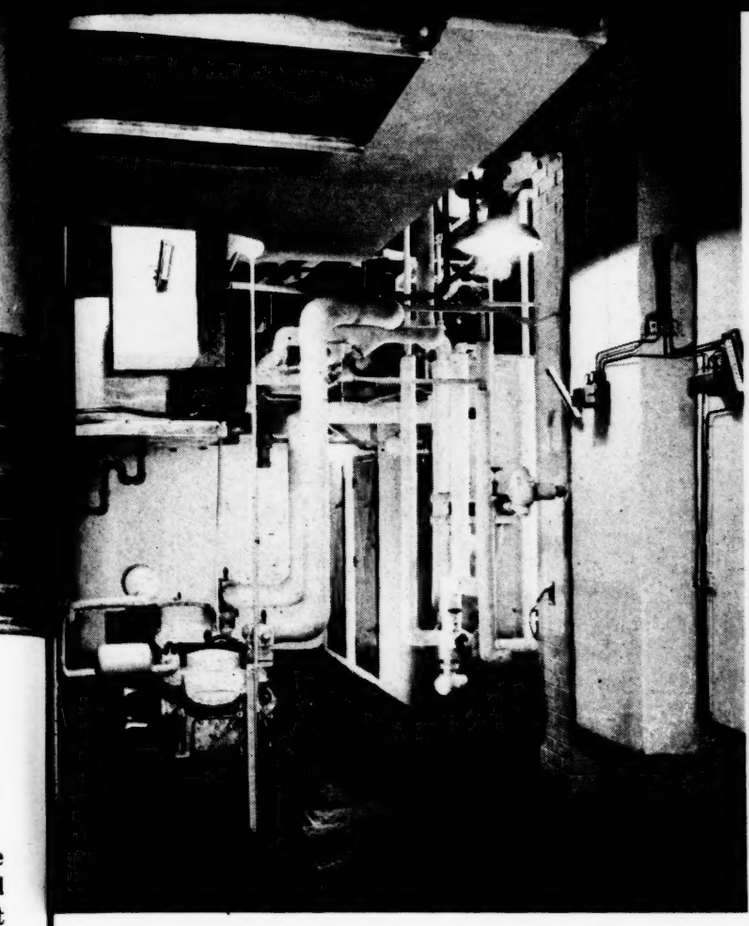
Executive and business offices, occupying the entire west wing on both floors, are fully air conditioned and have been laid out to facilitate future rearrangement of offices by the shifting of hollow metal partitions. Fluorescent troffer units set flush in the metal acoustic ceilings will provide an average illumination of 50 footcandles throughout.

All permanent partitions in the 165-ft laboratory wing are of glazed ceramic tile, with movable hollow metal partitions for sub-offices and temporary enclosures. Controlled ventilation, with a minimum of 12 air changes per hour, is provided in the laboratory wing

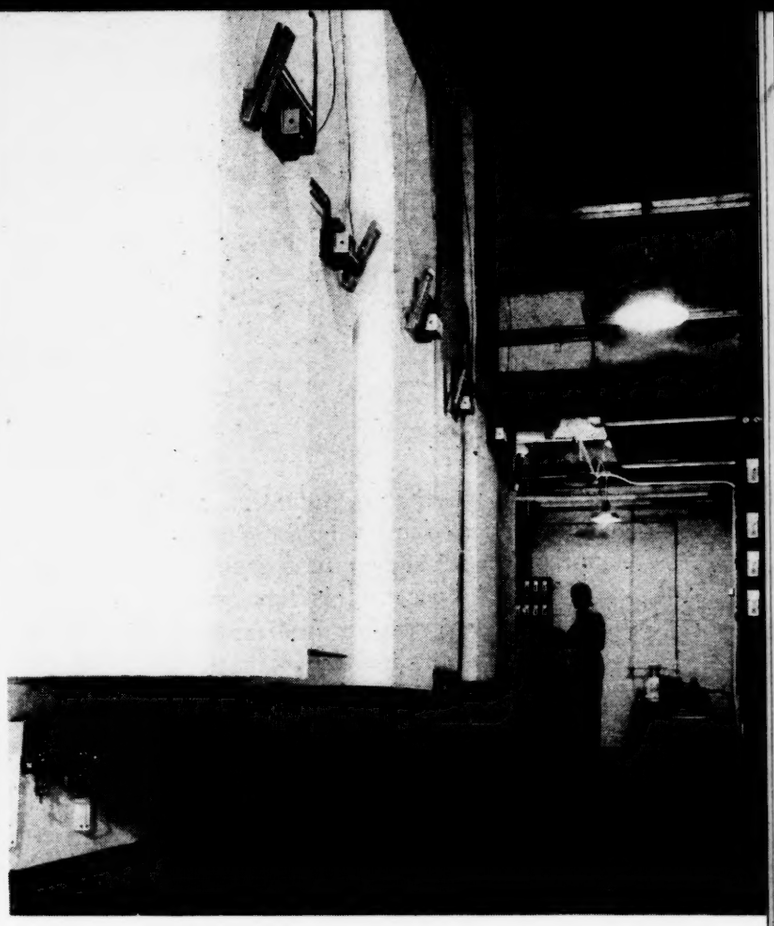


(Left) Two-foot walls separate individual laboratories from corridors. All air conditioning ductwork, service piping, and power distribution facilities are concentrated in these walls. Emergency safety shower can be seen at extreme left.

(Below) Motor-operated fans on the roof insure speedy exhaust of process vapors and heat developed in the laboratory wing, which is supplied with air by a special ventilating system with a capacity of 46,000 cfm. This unit consists of two fans in tandem, and delivers 100% cutside air which is filtered before distribution to the laboratories.



A portion of the 14-zone air conditioning system serving the office section, cafeteria, and meeting room. Two compressors serve air conditioning units suspended overhead.



Each duct is equipped with a low-limit thermostat and indicating thermometer mounted at eye level, and a mixing damper motor mounted on the wall below the duct end.

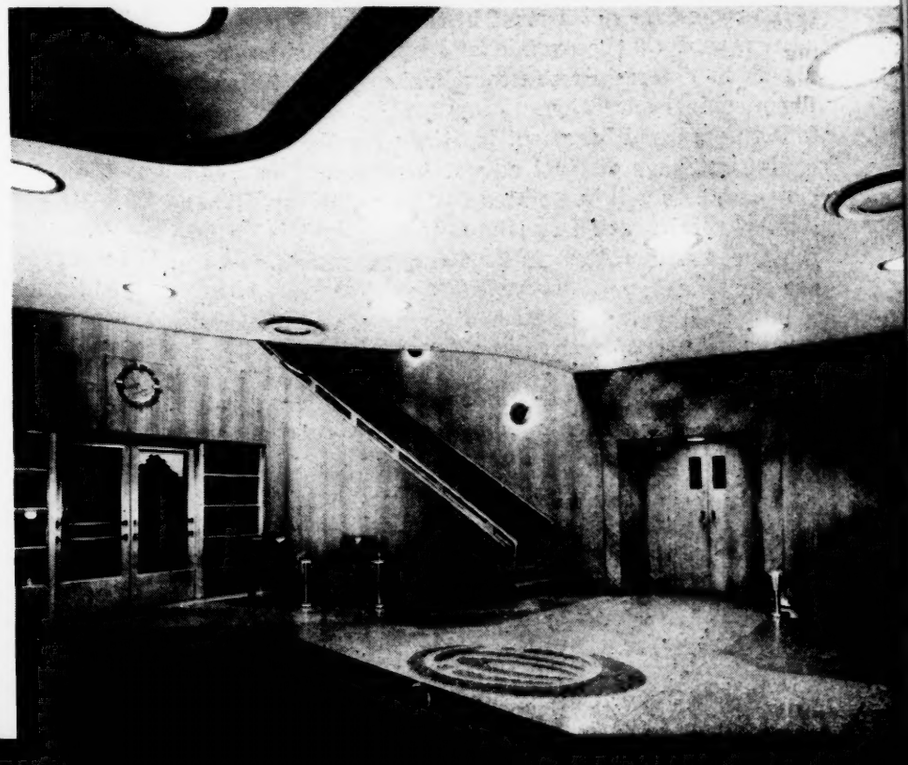
by means of a 46,000 cfm fan system and motor-operated exhaust fans on the roof, which serve the individual laboratory hoods.

All service piping, including hot, cold, and distilled water, compressed air, vacuum, and illuminating gas—as well as power distribution lines and ventilating duct—has been carried through this area in two-foot walls along the corridors. All unoccupied space within these wall areas has been equipped with enclosed bottle storage racks, with flush doors which have been painted to form an integral part of the corridor walls.

The building has been designed for ultimate expansion to approximately twice its present floor space; first by extension of the third floor, for which stub columns have already been provided, and secondly, by extending the present U-shaped structure into a hollow square.

Boilers and ventilating equipment have been located on the ground floor beyond the building line, and are covered by a paved terrace in the court, which is accessible from the reception lobby. Air conditioning equipment, with an aggregate cooling capacity of 160 tons, has been installed on the ground floor directly below the administrative and office area, which is served by the main 14-zone system, and is adjacent to the meeting room and cafeteria, which are independently air conditioned from the same equipment room.

Special provision has been made for neutralizing acids and other laboratory waste at an isolated point in the rear of the building, where proximity to freight elevators and receiving platforms will facilitate handling of the required neutralizing agents.



View from the receptionist's desk in the entrance lobby.

Roof or Basement Locations for Air Conditioning Equipment

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In determining whether refrigeration equipment for air conditioning systems should be installed in the basement or on a building roof, many construction, engineering and operating factors must be considered. These two designs are examined by the author and attention directed to the merits of each.

UP to a few years ago, the prevailing practice of many designers was to locate the refrigeration system for the air conditioning installation in a basement or subbasement machine room, irrespective of refrigeration capacity required. With basement installations, foundations for the main pieces of equipment such as refrigeration compressor and driving motor or turbine, chilled water and condenser water circulating pumps could rest on bedrock underlying the building foundations. This was a logical location then, due, in part, to the available equipment which was bulky, heavy in weight and noisy. In the case of slow speed reciprocating compressors, vibration and pounding had to be counteracted. In addition, operation of the equipment was generally manually controlled. Therefore, a basement machine room was convenient for the full attention of the operating engineer.

Today, the wide choice of equipment changes this picture. The development of automatic, compact refrigeration equipment, and the evaporative condenser for water conservation, have resulted in a system which can be located anywhere in the building, providing adequate means of isolation are installed.

The alert designer will recognize that basement machine rooms are not a must in the overall design of a system and that economic and space considerations should be determining factors in the final selection of the machinery location.

Both roof and basement locations for the necessary equipment have distinct advantages as well as disadvantages. As will be pointed out later, the capacity in tons of refrigeration for the proposed plant is an important consideration in arriving at a satisfactory decision.

Roof Installations

Data regarding seven important points that enter into the decision of where to locate the refrigeration machinery, will now be discussed.

USE OF EVAPORATIVE CONDENSERS—When the refrigeration compressors are located within a machine room on the top floor of a building or a penthouse designed for this purpose, evaporative condensers can be located within a very short distance of the compressors. Since such condensers can be located on the compressor room roof above or alongside of the penthouse, usually there is no problem of air supply and discharge for the equipment. This arrangement eliminates the need for water-cooled condensers, cooling tower and circulating pump and also reduces the cost of refrigerant piping. The compressor brake hosepower per ton of refrigeration can be kept to a minimum by the installation of adequate size evaporative condensers, thereby reducing the actual cost of operation.

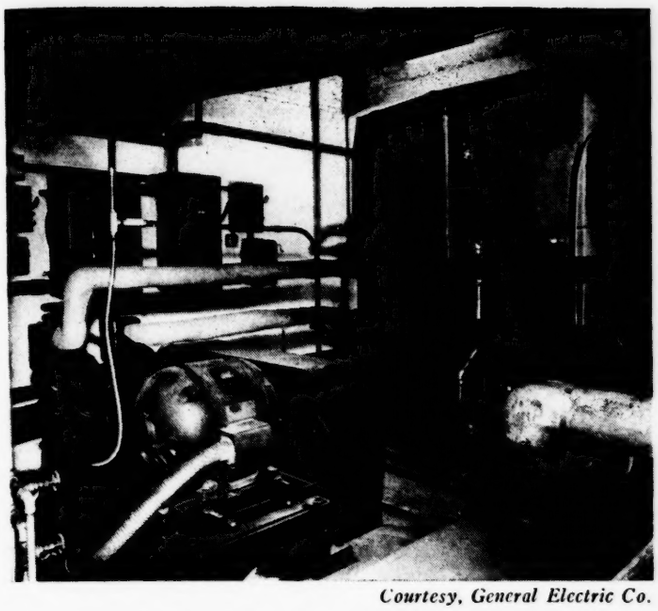
The physical size of the evaporative condenser is usually smaller than that of an equivalent capacity cooling tower. Maintenance of the evaporative condenser depends on its construction; a well designed condenser should have upkeep similar to a cooling tower. Water treatment for both types is very desirable, especially in contaminated air surroundings, to protect condensing coils and condenser tubes. Prime surface condensing coils with corrosion-protected metal such as hot-dip galvanizing or non-ferrous tubes and corrosion-resistant fans are very desirable.

Evaporative condensers can be enclosed in a louvered shell similar to cooling towers to improve their appearance.

MULTIPLE UNITS—It is economically feasible to divide the total required refrigeration capacity between several compressors. The evaporative condenser installation can likewise be made with separate coils or a separate unit for each refrigeration compressor. This arrangement provides flexibility in the operation of the plant under varying load requirements and can readily be accomplished with the roof installation due to the close spacing of all equipment.

AUTOMATIC CONTROL—The development of automatically operated refrigeration equipment lends itself to the roof installation. Refrigeration compressors and evaporative condensers can be readily controlled automatically by a means such as the chilled water temperature. This arrangement provides maximum economy of operation in matching the required load and does not require continual supervision by the operating engineer. Periodic supervision by the operating engineer to check machine operation, oiling and pressures, can readily be combined with other duties. A bell or light in the operating engineer's office connected to the high pressure cut-out and to the low temperature chilled water thermostatic cut-out, will give added protection to the system in case of faulty operation.

SIZE OF SYSTEM—The total capacity of the refrigeration system is a paramount factor in the determination of location. Small and medium tonnage installa-



Courtesy, General Electric Co.

Central air conditioning system installed in the basement of a 12-story office building in New York City. System consists of a G-E 60 hp motor compressor unit, illustrated, and a companion unit driven by a 75 hp motor.

tions that lend themselves to the use of reciprocating compressors, either singly or in multiple, have greater economic advantages when located in roof machinery rooms than do large tonnage installations which generally require centrifugal or axial-flow compressors. The latter are built with integral water-cooled condensers and therefore require a cooling tower. The high weight concentration of the cooling tower over a small area calls for heavier structural framing and supports. Usually this is not the case with the smaller capacity, lighter weight reciprocating compressors. It would be impossible to set up an arbitrary tonnage figure as a boundary between reciprocating and centrifugal compressors, for each installation should be analyzed from a cost standpoint and decided on its own merits.

VENTILATION—Adequate ventilation of machinery rooms is often a problem to the designer. It is obvious the roof installation can be readily ventilated at a minimum cost due to its close proximity to outside air. Ductwork required for the basement location can be eliminated and it is not difficult to locate the fresh air intake and exhaust louvers. In some roof installations, the evaporative condenser can be set at one end of the machinery room with the outside air intake louvers placed at the opposite end. The condenser fans will then augment the machinery room ventilation by drawing air across the compressor area.

LOCATION OF AIR CONDITIONING EQUIPMENT—The location of the air conditioning equipment can play an important part in arriving at the best location for the refrigeration equipment. When the air conditioning equipment is located in the upper floor or penthouse fan rooms of a building, it is obvious that a most economical installation can be made should the refrigeration equipment be located nearby. With the development of primary air conditioning systems used in conjunction with individual room conditioners, a penthouse or top floor fan room has decided advantages, and lends itself to such an arrangement. There are other less obvious advantages such as the lower static water pressure on the chilled water circulating pump casing which exists when the pump is located at the top of the closed circulating system. This arrangement minimizes stuffing-box seal maintenance problems.

MACHINERY SPACE—The location of equipment presents an economic problem, especially in rental type of buildings. For example, in large cities where the building cost per cubic foot is high, the basement area, which is usually reserved for refrigeration equipment, can yield a good return when rented for restaurant or similar use. This basement use for a restaurant is feasible if good air conditioning and ventilation are provided and arrangements made for a ground floor entrance. In some cases, the elimination of costly rock excavation required for a subbasement equipment room can materially change the construction cost. With the increasing use of district steam, the basic need for high ceiling boiler rooms is eliminated and this tends to further reduce excavation cost. The exclusion of a high ceiling refrigeration equipment room can again help reduce these costs. It must be remembered that the refrigeration capacity of the installation, as discussed previously, plays an important part in the analysis.

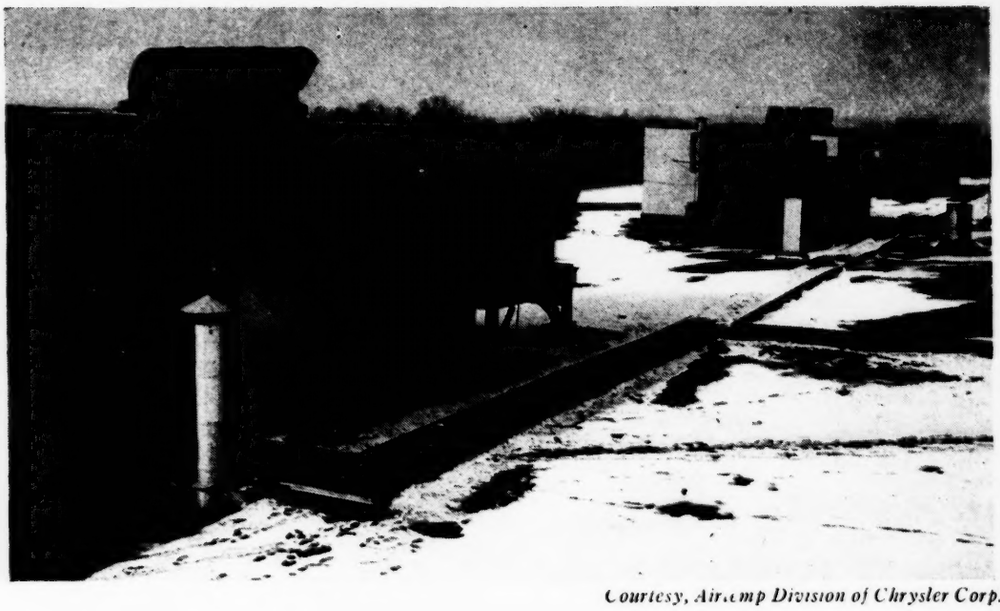
Disadvantages of Roof Installations

SUPPORTING STRUCTURE—The roof installation obviously requires both a supporting structure for the dead weight of the equipment and adequate bracing for unbalanced loads. The additional steel requirements in the form of columns, girders and beams is a function of several variables so no arbitrary standards can be established. For example, the installation of multiple smaller capacity refrigeration compressors and evaporative condensers does not present the same structural problem that would be encountered with one or two large capacity units. In the former case, by judicious location of the equipment with reference to the main load supporting columns and beams, the cost of additional framing can be minimized; in the latter case, the supporting structure must be designed to meet the expected loadings which may result in deep section girders and beams.

This situation can increase the floor to floor heights to maintain proper headroom under the structural supports. The building height directly affects the cost of additional steel for columns. A skyscraper type of building, with multiple setbacks and with high refrigeration requirement, obviously is not as well suited to a roof installation as a building of lower height and with uniform floor areas. The designer should analyze each type of structure on its own merits. In many cases, the floor loading selected by the structural engineer for fan rooms is suited to the loading imposed by small tonnage refrigeration equipment without additional steel framing.

VIBRATION—Reciprocating compressors located on a building roof present problems of vibration isolation to prevent transmission and telegraphing of this motion to the occupied portions of the building. Small multicylinder compressors do not create the same situations as large compressors of slower speed. Several types of vibration-absorbing bases and foundations

Four penthouses shown contain the air conditioning equipment to serve west half of company's factory and office area. Penthouse contains fan, compressor, air handling unit, expansion coils, heating coils and evaporative condenser.



Courtesy, Aircemp Division of Chrysler Corp.

are available, each engineered to the particular type of installation. Specialists in vibration-control should be consulted. The installed cost of these foundations have a role in making the final economic analysis of the installation.

It is not costly to isolate a small compressor and the same type of isolation would generally be used irrespective of the equipment location. Large units require spring-supported floating structural subbases which in turn must be properly supported by the building. In some cases, weight must be incorporated in the base to absorb unbalanced forces.

It is desirable to isolate interconnecting piping from the building structure by the use of isolated pipe hangers and flexible seamless tube type connections at the equipment.

SERVICES TO EQUIPMENT— Electric power must be carried from the main service location, usually located in the basement, to the equipment on the roof. The cost of this service will depend on the distance involved and the wire size. When the fan room is located nearby, both power requirements can be combined; this is less costly than where a separate service is run to each. Separate metering and switches can be located in a service center.

Since the water supply must be brought to the evaporative condenser or cooling tower, irrespective of where the design places the refrigeration equipment, no new situation is established. Water can be taken from the main water supply for the water-cooled stuffing-box seals, make-up water for the chilled water system, and for similar needs.

INSTALLATION OF EQUIPMENT— The cost of rigging refrigeration equipment to a roof location will usually be greater than for a basement location. Rigging costs should be estimated for each location and this figure used in the cost analysis.

Whether the refrigeration equipment is installed in the basement or on the roof can only be decided after a study has been made of the advantages and disadvantages of each from the construction, engineering and operation standpoints. Because of the many variable factors involved, neither location can be arbitrarily chosen. While this article brings into focus the majority of these points there are other factors, peculiar to each installation, which must be considered.

Omaha Bank Melts Blizzards

The corner of any big city bank is always a busy spot, and the corner occupied by The Omaha National Bank of Omaha, Nebraska, is no exception to the rule. In previous Nebraska winters, maintenance crews from the bank were busy every snowfall shoveling snow and slush from the 5,200 sq ft of pavement space that surrounds the bank to keep it clean for pedestrian traffic.

But last winter, during the record snowfalls that blanketed Nebraska, the bank's corner was more popular than ever, and the crews were freed for other duties. No matter how many people paused gratefully to stamp ice and slush from their feet on the clean pavement of the Omaha National, the pavement stayed clear. A snow melting system, consisting of warm water and anti-freeze circulating through a grid network of wrought iron pipe beneath the pavement's surface, was also "working for the bank."

The system installed by the Omaha National was designed to remove snow at the rate of one inch per hour, and bank officials feared that at that rate, snow might not be melted as fast as it was falling during some of the blizzards and squalls. No difficulties were experienced, however, and the snow melted at an even, rapid rate.

Wrought iron pipe, set in grids of 20 by 30 ft, was utilized throughout the snow melting system, with header piping of 2-inch diameter and 1-inch grid pipe carrying the water and anti-freeze combination heated to a temperature of 165F.

STORING SOLAR HEAT IN CHEMICALS

A REPORT ON THE DOVER HOUSE

MARIA TELKES
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and

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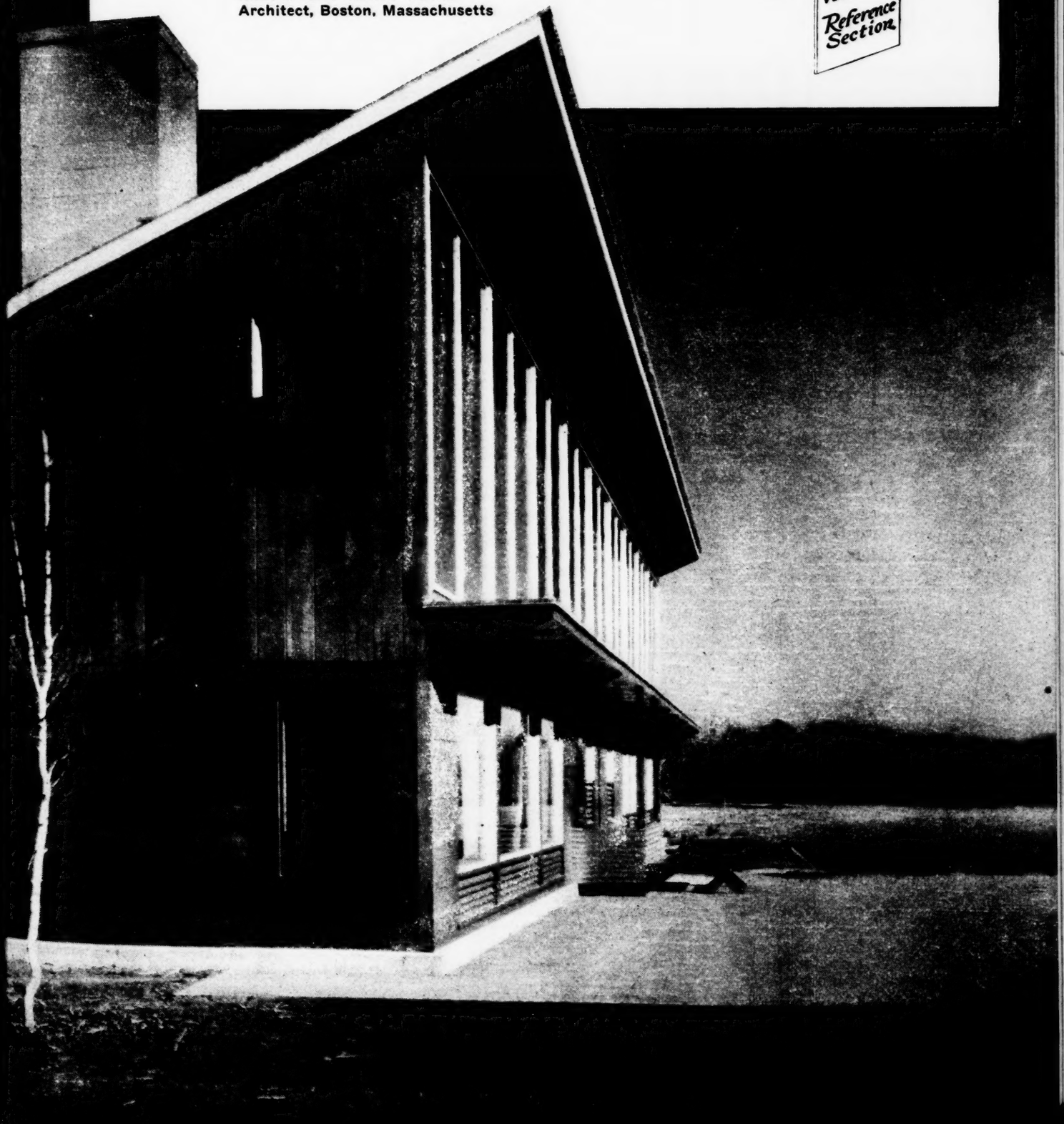
Architect, Boston, Massachusetts



Storing Solar Heat in Chemicals —a Report on the Dover House

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ELEANOR RAYMOND
Architect, Boston, Mass.

A house completed in Dover, Mass.,* and occupied since December, 1948, uses the heat of fusion of low cost chemical compounds for storing solar heat. Preliminary experimental results which are given indicate good agreement with calculations. However, complete tests will have to wait until the end of the present heating season.

VARIOUS methods used experimentally for the heating of houses with solar energy were reviewed in an article in HEATING AND VENTILATING, September, 1949. Calculations were presented to show the efficiency of solar heat collection.

The storage of solar heat was found to be the critical problem. The principles of the chemical heat storage method were presented, using the latent heat of fusion of chemical compounds for the storage of the energy of the sun.

To demonstrate the validity of these calculations and to test the performance of the chemical heat storage method, a house was built in Dover, Mass., about 15 miles from Boston, on the estate of Miss Amelia Peabody.

This house, which has been occupied since December 24, 1948, was not completed entirely until February, and therefore the most important part of the heating season was missed. The original plan was to collect solar heat during October and November when a surplus of solar energy is available. During December, January and February very little if any surplus heat can be collected, while during March and April an increasing surplus could be expected.

Tests cannot be regarded as being conclusive because during the most important part of the heating season the house was still under construction, or was not in normal operation. Tests therefore must be regarded as preliminary tests that supply interesting data on the amount of collectable heat, the attainable collector temperature and efficiency, and the heat transfer from the storage to the rooms.

Conclusive tests will be conducted during the 1949-1950 heating season, when the house, now completely finished, will be there to perform during an entire season.

*Solar house experiments described in this article were sponsored by Miss Amelia Peabody. This project is not connected with the Solar Energy project of the Massachusetts Institute of Technology.

Fig. 1. Metal plates of collector (left of photograph) painted black; the glass panes are in place at right.

Heat Collector

The south-facing vertical wall of the second floor is occupied by the collector. Its glass area consists of 18 double-glass-paned sections, each of them 4 x 10 ft, for a total glass area of 720 sq ft.

Such large glass panes had to be obtained at the lowest possible cost, which eliminated the use of hermetically sealed air-spaced glass. The lowest cost in large sizes can be attained by using figured glass, available in various patterns. Shallow patterns are preferable to dust-catching deeper configurations. Patterns like Velves, Luminex, or some others combine high transmission for solar energy with low cost—about 30c per sq ft.

In the Dover house, Pointex glass is used as it was available. The pattern diffuses the light to some extent and the black color of the collector plate, behind the glass, becomes less obvious. Due to reflection and scattering, the color of the collector glass generally assumes the color of the sky. This is important because the "forbidding black" collector was regarded as an architectural drawback. The use of regular window glass in such large units would have increased the cost greatly and would have presented a black appearance.

Two glass panes are used, with one-inch air spaces between them. They are mounted in a non-hardening sealing compound, in wood frames and made weather tight on the outside with sealing strips.

The 4 x 4-inch wood uprights holding the glass carry the collector plate, made of standard sheets of thin

gage galvanized iron. Double bent flat seams are used and all openings or holes are carefully sealed to prevent dust deposition between metal and glass. The metal plate is nailed directly to the back side of the uprights. Fig. 1 reveals the black color of the painted metal and the apparent change as the glass is being installed.

Non-galvanized black-iron sheet would have been equally satisfactory. Both sides of the metal sheet are painted with a rust inhibiting primer and the front side is painted a flat black.

The entire collector is divided into three units, two each of seven glass sections and a smaller unit of four sections. An air duct of 3⅝ inches deep is formed between the back side of the collector plate and an insulated panel wall closing off the duct. To circulate the air, a horizontal baffle of wood is introduced in the center, Fig. 2. Space behind the collector plate is divided into two parts, each 48 x 3⅝ inches, or 175 sq in. cross-section. Edges of the air ducts are sealed carefully to prevent any air leakage.

The top edge of the duct, near the roof, is packed with insulation 6 inches thick to prevent marginal heat losses. Insulation behind the collector consists of a vapor barrier, rockwool and fiberboard, giving an overall heat loss coefficient of U = 0.12. In the calculations, a loss coefficient of 0.15 is used to include the marginal heat losses.

Front losses of the collector plate (through two air spaced glass panes and an additional air space between metal plate and glass) is U = 0.55 and the overall loss factor of the collector is therefore U = 0.70, from front and back sides, per square foot of collector plate. This figure is applicable if the collector temperature is less than 100F; at higher temperatures the overall loss factor increases.

Circulation of the air from the collector to the storage is shown in Fig. 2. The downward duct has adequate cross-sectional area (more than 2 sq ft) and the

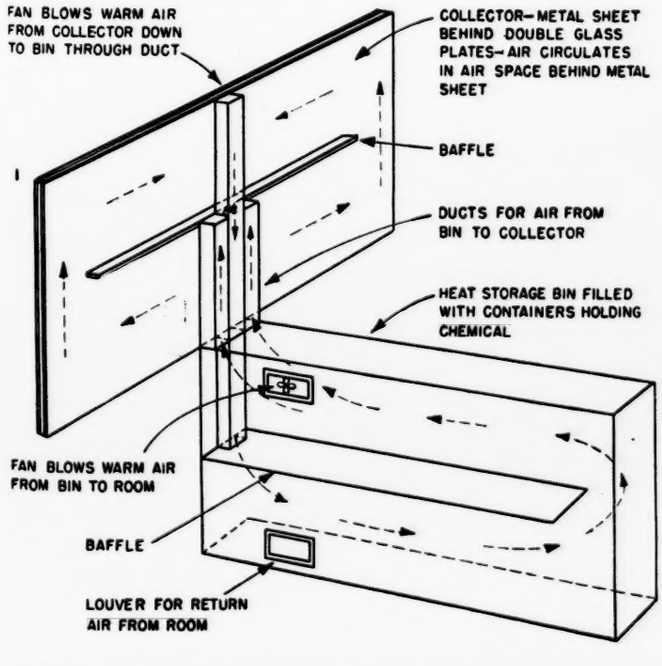

FAN BLOWS WARM AIR FROM COLLECTOR DOWN TO BIN THROUGH DUCT
COLLECTOR—METAL SHEET BEHIND DOUBLE GLASS PLATES—AIR CIRCULATES IN AIR SPACE BEHIND METAL SHEET
BAFFLE
DUCTS FOR AIR FROM BIN TO COLLECTOR
HEAT STORAGE BIN FILLED WITH CONTAINERS HOLDING CHEMICAL
FAN BLOWS WARM AIR FROM BIN TO ROOM
BAFFLE
LOUVER FOR RETURN AIR FROM ROOM

Fig. 2. Diagram of the collector and the heat storage bin.

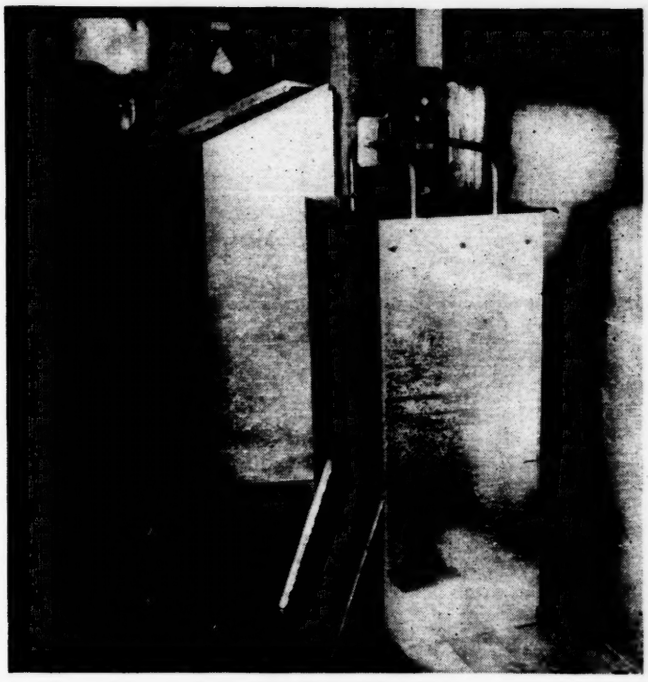


Fig. 3. Air circulating fan placed in the down duct of the air distribution system.

air circulating fan is mounted directly into the duct, in Fig. 3. The two ducts returning the air to the collector have ample cross-sectional areas and any restriction or bottleneck is carefully avoided. Automatic louvers are provided to prevent any air circulation during the night and on cloudy days.

Fans are operated through a thermostat, with its bulb in the air space behind the collector plate.

During the morning, the temperature of the collector plate starts to increase soon after sunrise, warming the air in the duct behind the plate. The warming-up period is of variable duration, depending upon the amount of solar energy reaching the collector. The thermostat is adjusted in such a way that the fans start operating when the air temperature in the duct is above 100F; the fans are automatically disconnected when the duct temperature falls below 95F. This temperature differential is sufficient to prevent too frequent switching on and off. The heat capacity of the collector is advantageously low, but an occasional passing cloud, obscuring the sun for 10 to 15 minutes generally does not lower the duct temperature sufficiently to disconnect the fans. The warming-up period, required during the morning, is to some extent regained during the late afternoon, when, on clear winter days, the collector operated almost until sunset.

Propeller type fans are used. The three sections of the collector have one fan each and the total air circulated by them in 3,260 cfm. The total current consumption of the electric motors changes into heat, but this heating effect is negligible.

Heat Storage Reservoirs or Bins

The three sections of the collector are connected to three heat storage bins. One of the larger units serves the two bedrooms, the smaller unit is located between

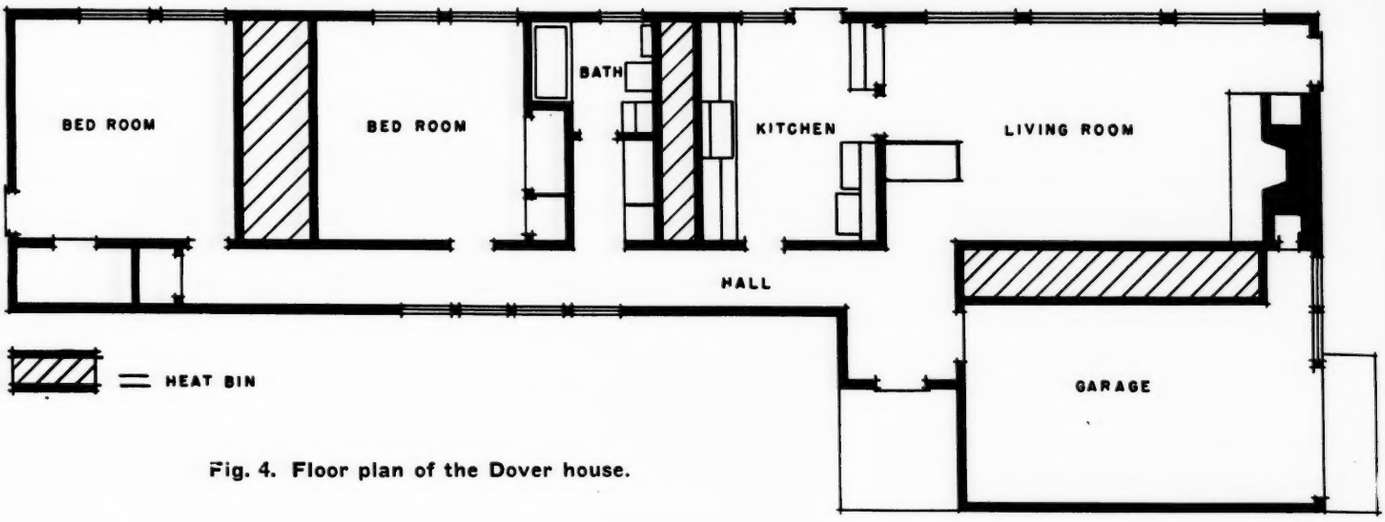


Fig. 4. Floor plan of the Dover house.

the bath and kitchen, and the other larger unit is on the north side of the large living room and it also serves the hall. Location of the bins is shown in Fig. 4. Total floor area of the bins is 130 sq ft and the total volume of the empty bins is just 1,000 cu ft.

Location of bins. The usual tendency followed by most architects is to place the furnace in the basement to get it out of the way. It is well known that it is impossible to insulate a heat source completely except at a prohibitive thickness and cost of insulation. A basement trench, or room, housing the solar heat storage, or the distribution of the heat storage units below the floor between the floor joists, looks well on paper. While it saves space, it dissipates a great deal of heat. Placing the heat storage in the attic creates the same problem of insulation, but, in addition, its weight has to be supported, at additional construction costs. In any position it is impossible to prevent a continuous heat leakage loss from storage into the surroundings.

Why not make a virtue of an unavoidable necessity? By placing the heat storage bins between the rooms the heat leakage is to a great extent directed into the rooms and the walls of the bins are changed into radiant heating panels, supplying a background heating effect. The floor and the ceiling of the bins are insulated heavily to diminish heat leakage. The background heating effect from the bin walls is sufficient to keep the rooms comfortable, when the outdoor temperature is milder. When more heat is required, thermostatically operated fans circulate the air in the bins through the rooms to supply additional heat; the colder air of the rooms returns to the bins through louvers.

Containers. Calculations indicated that a total heat storage volume of 3,500 gallons or 470 cu ft was required, or about 21 tons of the chemical mixture. It was decided to use standard 5-gal drums, with screw cap closures. These drums were selected because they were available at a low enough cost. During the summer of 1948 there was a shortage of containers and we had to take what we could get. Dimensions of the drums are: 11½-inch diameter and 13¼-inch outside height. Area of the cylindrical envelope is about 3.3 sq ft. Fig. 5 shows one of the heat storage bins.

Drums, which are stacked to form vertical columns seven drums high, are arranged about one inch apart leaving ample space for the circulation of the air. There is a horizontal, thin baffle, shown in Fig. 5. Warm air passes first through the lower layer of three drums, then through the upper layer of four drums. Drums nearer the floor are in contact with the warmer air. The heat transfer between the top and bottom surfaces of drums stacked into columns is effective.

The total collector surface is 720 sq ft and the heat storage volume is 470 cu ft. Therefore, the solar heat collected by one square foot of collector is stored in 0.65 cu ft or about 60 lb chemical mixture. The total exposed surface of the heat storage drums in contact with the circulating air is about 2,400 sq ft. Solar heat collected behind the 720 sq ft collector therefore passes over 2,400 sq ft heat transfer surface. This was adequate to prevent local overheating of the chemical adjacent to the drum walls. Even on very clear days the temperature of the drum walls was seldom more than a few degrees above the inside temperature of the drums.

The chemical mixture filling the drums consists of commercial anhydrous sodium sulfate, Na_2SO_4, mixed with the required amount of water and small amounts of additional agents for the promotion of crystallization and the inhibition of corrosion. The drums were filled by the Chemical Development Co. using standard filling equipment. During filling, the mixture was kept above its melting point, forming a slurry which was stirred rapidly to maintain a uniform charge. The canning or packaging of the mixture does not involve any difficulty and with the proper equipment, it is a simple and rapid operation.

Needless to say the containers are permanently sealed. They do not leak or produce any gas or odor, and it is expected that they should last indefinitely. Thus far no rusting of the containers has been noticed. Each bin has a removable door panel, opening into the hall-corridor and the drums can be inspected easily. The process of melting and solidification of the chemical can be observed, by tapping the walls of the drums. The presence of solid or liquid can be noticed from the sound produced in response to the tapping.

Measuring Instruments

An automatic 6-point thermocouple recorder of the Brown Instrument Co. is installed, printing points on

a continuous chart. Iron-constantan thermocouples are used to indicate the temperatures of the following points: Outdoor, indoor, heat storage drums, air leaving the collector (air down), air leaving the heat storage bin (air up), air behind lower part of collector.

Each day's record is a chart strip 48 inches long. An additional weekly chart-type recorder is used to obtain weekly outdoor temperature records.

Other thermometers are used at various places to indicate the temperatures of different parts of the collector and the rooms.

Air velocity in the ducts was measured and checked occasionally.

Solar energy data were kindly provided by I. F. Hand in charge of the solar energy observations at the Blue Hill Observatory. The Dover house is about 5 miles from this observatory. This distance is negligible and the records are considered identical during one day.

Electric power consumption of various electrical appliances used by the occupants of the house is measured directly.

It is obvious that the recording and measuring instruments are for experimental purposes and they are not otherwise required.

Architectural Features

In designing this house, the architect was faced with certain very definite restrictions which the heating system imposed. The restrictions included, as has already been shown, the incorporation into the design of the house of a collector plate which must be as long as the house itself and 10 ft high, a rather formidable feature to be handled and still keep the house livable in character and domestic in scale. The architect felt strongly that the natural benefits of sunlight and view to be obtained from large south windows in the living rooms could not be sacrificed to the placing of the collector in the south wall of these rooms. Obviously, the collector plate could be effective only if it faced due south. The finished house is shown on page 79.

There were several ways in which this problem could have been solved. The architect chose to put the collector plate in a second story where it could occupy an entire south wall and could still leave the south wall of the living portions of the house free for as many and as large windows as might be desired. As a result, the south wall of the living-dining room is practically all glass except for louvered shutters at the top and bottom which, because the windows are of fixed double panes, provide ventilation. Each of the two bedrooms has two large south windows with similar louvered shutters. Winter sun admitted by all these south windows has provided direct heat for sunny days and on these days heat has been drawn from the storage bins only during early morning and at night.

Since the collector plate is of a size calculated to produce heat for only one floor, the second floor is used for storage. This attic space is reduced to a minimum by carrying the roof down to make a single story on the north side. This north side provides the garage space which is not heated, the entrance, and passage to bedrooms, all of which need a minimum of light. Windows on the north side add a minimum to the heat

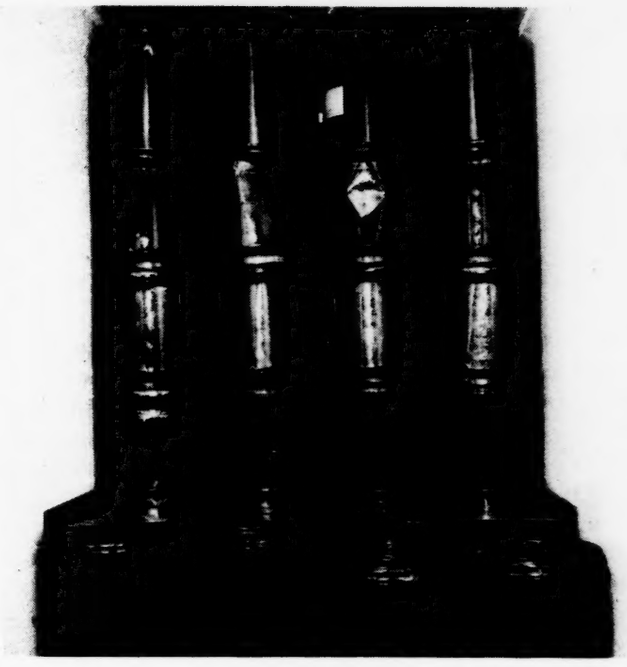


Fig. 5. Solar heat storage bin partly filled with 5-gallon drums.

load. To the casual passer-by this two-story house, with its huge glass area occupying the entire second floor, may at first seem somewhat startling in its bold outlines and upward sweep but, like all frankly-met solutions of new challenging problems, its logic soon makes it convincing and it has already settled down to be an accepted part of the landscape. Simple planting of birch trees and a paved terrace are part of the landscaping.

A feature that gives character to this two-story south side is the projecting eaves of roof and the first floor visor. These pleasantly break the vertical lines of the house, seemingly reduce the height, and give a natural place for introducing a contrasting color—clear sunny yellow with the red-brown siding of the body of the house. Again, a purely functional device has helped the design, for the primary purpose of the overhangs was to screen the summer sun from both collector plate and windows. An unexpected boon is the way the glass covered collector plate reflects sky-color and cloud-pattern, diminishing the black effect.

As stated previously, the problem could have been solved in other ways than by putting the collector plate in an attic story. The plan might have been reversed, with collector plate on the first floor and living quarters on the second. This would be a particularly desirable solution for a house placed on a hillside where distant views might profitably be widened. This Dover house is surrounded by flat cultivated fields and orchards which are especially to be enjoyed from the first floor.

Still another solution would have been to place the collector plate in free-standing walls extending out from the house. This would have had the advantage of leaving the design of the house itself less affected by the collector plate, particularly since the house could then be independently oriented to take advantage, if need be, of views or contours, and the south-facing walls could be placed at any necessary angle to the house. Since the Dover house is built as far north as

seemed wise for this experiment, it was felt that the most compact relationship between collector plate and storage material was desirable. In a more southern climate other arrangements of the collector plate and storage would be entirely feasible.

The plan of the house as well as the exterior was very definitely determined by the heating system. The length of the collector made it expedient to arrange the rooms in a straight line, with a connecting corridor on the north side.

It is perhaps well to state again for emphasis that all these conditions which have gone to make this house what it is, had to be taken into account primarily because of the climatic conditions inherent in this particular problem. A house built in another, and especially in a more southern locality, would present entirely different problems and the designing and planning of such a house could be done with fewer restrictions. That is why every sun-heated house must be designed independently. This Dover house could not, as many inquirers seem to think, be successfully set down in another locality where climate, surroundings and family demands would be bound to be different. Every such house has its own set of circumstances to be taken into the calculations.

Heat Balance Calculations

The heat load of the Dover house is estimated from the following data of construction.

Walls—Typical frame construction, with wood sheathing and finishing boards on the outside, 3⅝-inch mineral wool between studs, with vapor seal, air space, and decorated plywood (Welltec) as the inside finish.

Doors — Standard 1¾-inch weatherstripped doors with storm doors.

Windows—Permanently mounted Thermopane, ¼ inch plate glass, with ½ inch air space. At night double aluminum painted shades are drawn providing two extra air spaces. The shades are drawn for a night period of 14 hours during the winter months.

Ceiling—Joists covered with the floor boards of the attic, 4-inch insulation between joists (except over bins and ducts, where insulation is 6-inch thick). Aluminum vapor seal, air space and ½ inch thick insulating board for the inside finish of the ceiling.

Floor—This is laid over 12-inch cinders, topped by a one inch layer of grout, mopped with hot asphalt. A layer of asphalt saturated felt is placed on top with 2-inch thick peripheral insulation and again mopped with hot asphalt. The floor slab is of 4-inch thick Vermiculite concrete with a surfacing layer of grout. The heat loss estimate followed the recommendations of R. S. Dill.*

The areas *A*, in square feet, the heat loss coefficients *U*, Btu per (sq ft) (hr) (F), are summarized in Table 1.

For an average degree day of 1,100 a month or a daily degree day of 35.5, the average daily heat loss through the house will be 300,000 Btu per day.

Infiltration losses of the weatherstripped doors could be calculated according to standard practice. The permanently mounted Thermopane windows had no infiltration losses. Infiltration losses through the well insulated and weatherstripped louvers had to be estimated. Taking these factors into account, the total inside volume of the house being 10,000 cu ft, one complete air change, with an average temperature difference of 35.5F, is equal to 6,400 Btu. Allowing for ample air changes in the house, the average daily heat load, including air changes, was estimated as 400,000 Btu per day.

TABLE 1—HEAT LOSS CALCULATIONS

Part of Building	Area, (A)	Coefficient, (U)	(A) x (U) x 24 hours
Walls	1,497	0.071	2,550
Doors	76	0.35	630
Windows	183	0.55 (day) 0.25 (night)	1,640
Ceiling	1,456	0.061	2,130
Floor edge length	190		1,450
		Total	8,400

The estimate of heat loss based upon the usual design temperature, or the average lowest temperature to be expected, will yield a different result. The design outdoor temperature in the vicinity of Boston is around —10F, corresponding to a maximum indoor-outdoor temperature difference of 80F, as compared to the

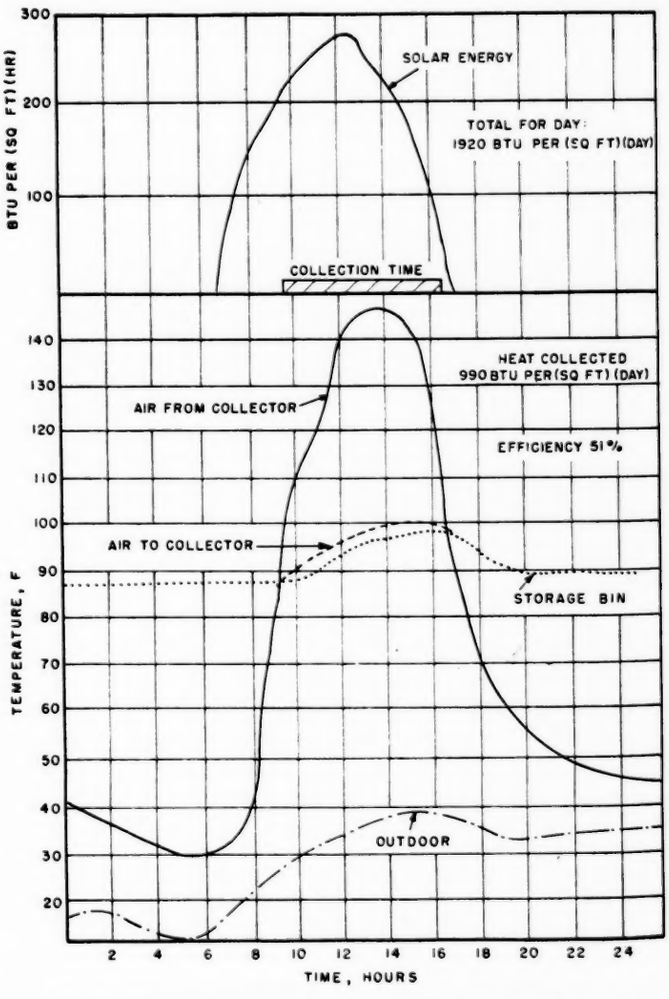


Fig. 6. Temperature and solar energy on February 8, a typical solar heat collecting day.

*R. S. Dill, W. C. Robinson and H. E. Robinson, Measurements of Heat Losses From Floor Slabs, National Bureau of Standards, *Report BMS 103*, 1945.

average temperature difference of 35.5F (for December, January and February). The heat load for the —10F outdoor condition will be 80/35.5 × 400,000 or 900,000 Btu per day or 37,500 Btu per hr. These figures are given only to establish comparison with the usual procedure. The heat balance of the Dover house is based upon the following simple equation:

$$\begin{pmatrix}\text{Total average daily heat load during December, January}\end{pmatrix} = \begin{pmatrix}\text{Average daily solar heat collected during December, January}\end{pmatrix}$$

Heat loss from house equals heat gained from the sun.

The solar heat collection of the Dover house was estimated for December and January as follows:

A total of 720 sq ft attic collector, with 40% efficiency, collects 406 Btu per (sq ft) (day) for a total of 290,000 Btu per day; 170 sq ft south-facing window on the first floor, was estimated to admit 110,000 Btu per day for a total of 400,000 Btu per day which is just equal to the average December-January heat load.

Heat losses through the windows have been included in the heat load of the house. Therefore, the transmitted solar energy through the windows (being 72% of the incident for December, January, February) is to be considered as net gain. To account for shading due to overhangs, 65% of the incident energy is used for December-January, 60% for February, and progressively less for other months.

The heat storage was calculated to store 4,700,000 Btu which is enough for 12 average days' heat requirements.

Experimental Results

The most important step was to compare the amount of solar energy incident on the south-facing vertical collector with the amount of heat delivered by the fans to the heat storage bins. Results for a typical collecting day (February 8) are shown in Fig. 6. Hourly values of the incident solar energy, Btu per (sq ft) (hr), are shown in the upper part of the figure. The duration of the collection is indicated. The hourly temperature values are shown for the entire day, giving the outdoor temperature, the temperature of the drums in the heat storage bin, the temperature of the air in the downward duct (air down) and the temperature of the air in the return duct (air up). It can be seen that soon after sunrise the duct temperatures increase.

As soon as the air circulation begins, the temperature in the air down duct rises abruptly, reaching its maximum of 146F around 1 to 2 p.m. The air returning from the bin, in the air up duct remains slightly above the temperature of the drums. The temperature difference between the air down and air up levels is proportional to the collected heat. On this particular day the incident solar energy was 1,920 Btu per (sq ft) (day) and the collected amount was 990 Btu per (sq ft) (day), giving an efficiency of 51%.

Outdoor temperature during the collecting hours was around 40F and the maximum temperature difference between collector plate and outdoor air was 106F, while the average was around 95F. The estimated collection efficiency predicted by computations for such temperature differences shows a collection efficiency of 45 to 53%, which agree well with the experimental results.

TABLE 2—DISTRIBUTION OF DAYS IN FEBRUARY, 1949

Days	Incident		Collected		Collected Incident = Eff. %
	Total	%	Total	%	
10 Dark (A)*....	1,620	5½	50	½	3
3 Partly cloudy (B)*.....	2,130	7½	740	6	34
15 Above average (C)*.....	25,460	87	11,230	93½	44
	29,210	100	12,020	100	41.2

*In Tables 2 and 3, *A* group received 0-479 Btu per (sq ft) (day); *B*, 480-959; *C*, 960 plus.

Similar comparisons for other days indicates that the performance of the collector was slightly better than the calculated prediction. This can be explained by the fact that the calculations assumed that the two glass panes transmitted only 72% of the incident solar energy, which is an average figure for the day. During the better part of the day (noon hours during December, January, February) the angle of incidence is very favorable and instead of 72% as much as 80% solar energy will be transmitted, with a resulting increase in the collection efficiency.

Complete results of the February tests of the Dover house are summarized in Table 3. The average incident solar energy was 1,040 Btu per (sq ft) (day), which is 17% lower than the normal mean of 1,250 Btu per (sq ft) (day). Values for the past 3 years are: 1,240, 1,255, 1,262. The degree days were 930, which is 16% lower than the normal mean of 1,110. The month of February was therefore 16% less cold than usual, but there was also 17% less sunshine than usual.

The average amount of collected solar energy was 429 Btu per (sq ft) (day), which corresponds to a 429/1,040 = 41.2% collection efficiency The distribution of the days is given in Table 2.

Total for house, Btu per month	
Collector	8,650,000
Transmitted through windows	2,950,000
	11,600,000
Heat loss = $\frac{400{,}000 \times 33.1 \times 28}{35.5}$	10,400,000

Cost Estimate of Materials

Collector		
Glass, 36 panes, 4 ft x 10 ft figured glass	$504	
Metal collector plates, 800 sq ft black iron, 28-gage	36	
Insulation behind collector, 800 sq ft at 50¢ per sq ft	400	$940
Heat storage		
470 cu ft containers at 50¢ per cu ft	235	
21-ton chemical mixture at $10 per ton	210	
Baffle sheet 130 sq ft black iron, 28-gage	10	
Insulation, 360 sq ft at 50¢ per sq ft	180	635

TABLE 3—ANALYSIS OF HEAT COLLECTED DURING FEBRUARY, 1949

Date	Degree Days	Sunshine Hours	Collection Hours	Group	Solar Energy, Btu per (sq ft) (day)		Efficiency %
					Incident	Collected	
1	37	8.1	6.3	C	1,740	790	45
2	43	9.1	7.0	C	2,040	815	40
3	46	7.8	5.7	C	1,740	665	38
4	39	—	—	A	110	—	—
5	41	3.5	2.3	B	840	150	18
6	45	6.9	6.4	C	1,450	715	50
7	33	0.5	—	A	110	—	—
8	34	9.1	6.8	C	1,920	990	51
9	22	8.0	7.3	C	1,370	595	44
10	34	2.3	3.0	B	610	260	42
11	41	7.6	4.9	C	1,420	530	37
12	49	10.0	6.8	C	1,820	850	47
13	23	1.6	0.8	A	440	50	12
14	17	3.5	4.0	B	680	330	48
15	22	0.1	—	A	230	—	—
16	21	—	—	A	180	—	—
17	33	9.2	7.5	C	1,960	1,220	63
18	39	9.7	7.2	C	1,940	930	48
19	19	6.2	5.5	C	1,360	475	35
20	27	0.5	—	A	200	—	—
21	37	9.4	5.1	C	1,600	440	28
22	38	—	—	A	110	—	—
23	25	8.2	5.7	C	1,430	665	46
24	31	9.0	6.0	C	1,720	570	33
25	31	—	—	A	60	—	—
26	31	—	—	A	100	—	—
27	36	10.3	6.9	C	1,950	980	50
28	36	—	—	A	80	—	—
Total	930	140.6	105.1		29,210	12.020	
Per day	33.1	5.0	3.75		1040	429	

Ducts		
Material	40	
Fans		
3 collector at $30		
5 room at $20	190	
Thermostats	60	290
Total material		$1,865

This analysis of the materials of the system used in the Dover house is without the additional expenses due to the development, variable costs of labor and freight charges.

The labor includes the following: Mounting the glass of the collector, painting and installing the collector plate, mounting the insulation panel, filling the containers with the chemical, insulating the bins and placing containers, mounting the ducts and fans, and electrical wiring of fans and thermostats.

Conclusions

Warm air circulated from the collector to the heat storage bin (air down) transmitted heat very effectively to the drums; the returning air (air up) was generally only a few degrees warmer than the walls of the drums.

Air circulation from the heat storage bins into the rooms has to take into account the comfort of the occupants. Each room has its own thermostatically controlled fan and these were, frankly, too large and too noisy, especially at night. Room fans as originally installed, delivered 600 cfm air which was far too much, giving short blasts of air. Fans are now replaced by smaller ones, circulating about 300 cfm, which appears to be more than sufficient. The noise problem of the bedrooms during the night has been improved. The smaller fans, about 1/100 hp, have the added advantage of lower cost.

The daytime noise of the collector fans is not at all objectionable and is generally hardly noticed. These fans are located in the attic duct and have soundproof mounting.

South-facing windows, especially those of very large size as those in the living room, admit a great deal of sunshine directly during the winter days. The visor over the windows is quite effective in diminishing the sunshine during the late spring and summer and prevents overheating. Smaller windows could have been used, although in this case the collector area would have to be increased.

It is not necessary to place the collector in the attic. It would be equally possible to install the collector in the south wall and in this way the need for an attic could be eliminated. Various arrangements are possible and the Dover house should be regarded as one of many possibilities.

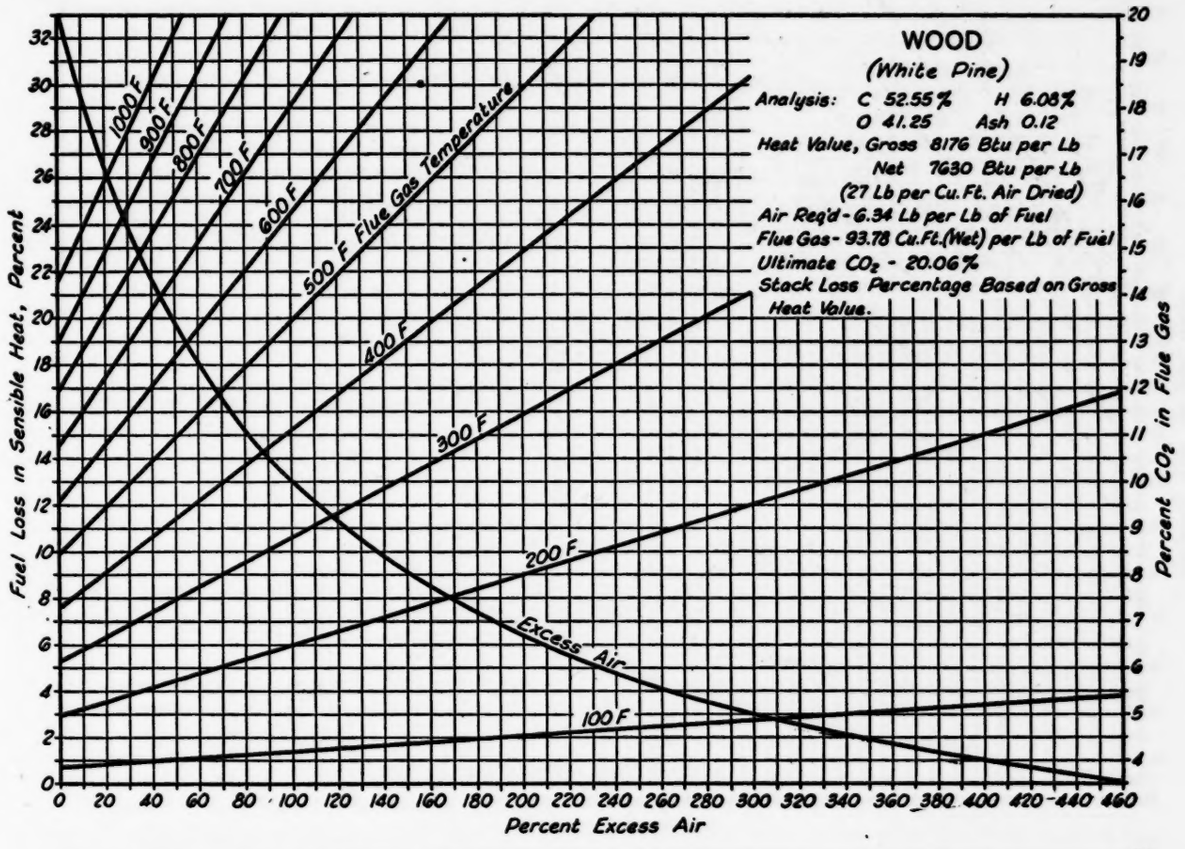
Some optimists may regard the rising of solar house-heating as the doom of the home furnace. Such a view is too far reaching, because many locations of the United States are devoid of sufficient winter sunshine.

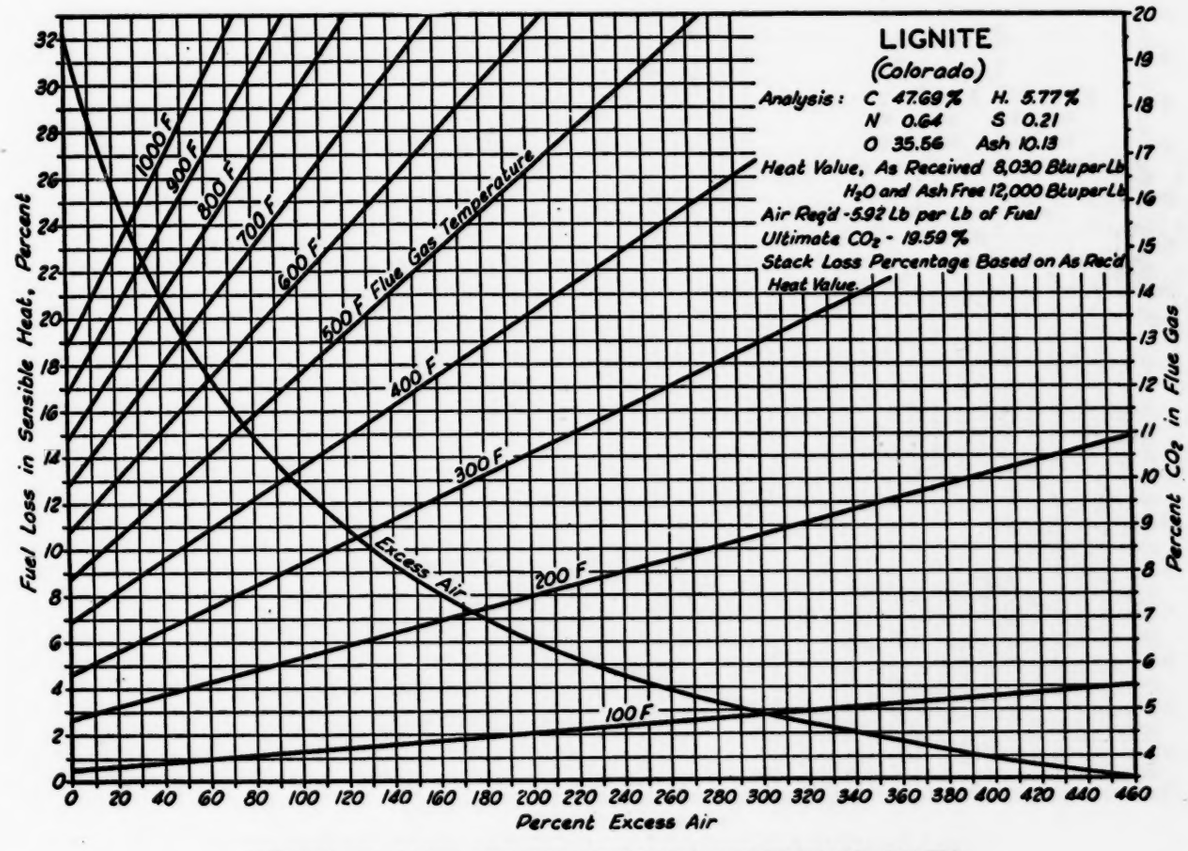
It is obvious that considerable development is needed to produce a packaged unit of solar house heating system. The Dover house should be regarded merely as a start. It is not to be considered as the final solution of the problem, but to stimulate interest in the utilization of the energy of the sun.

Bind in

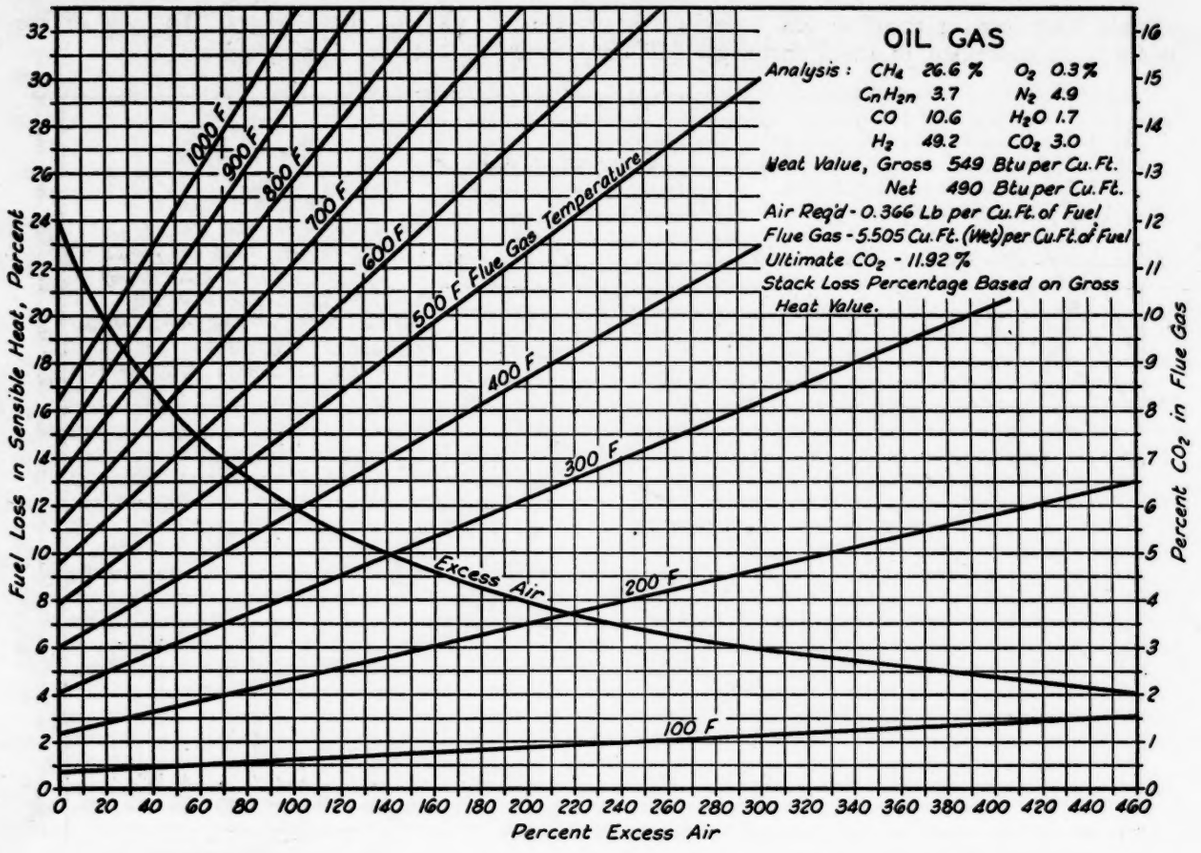
SENSIBLE HEAT LOSS IN FLUE GAS — WOOD AND LIGNITE

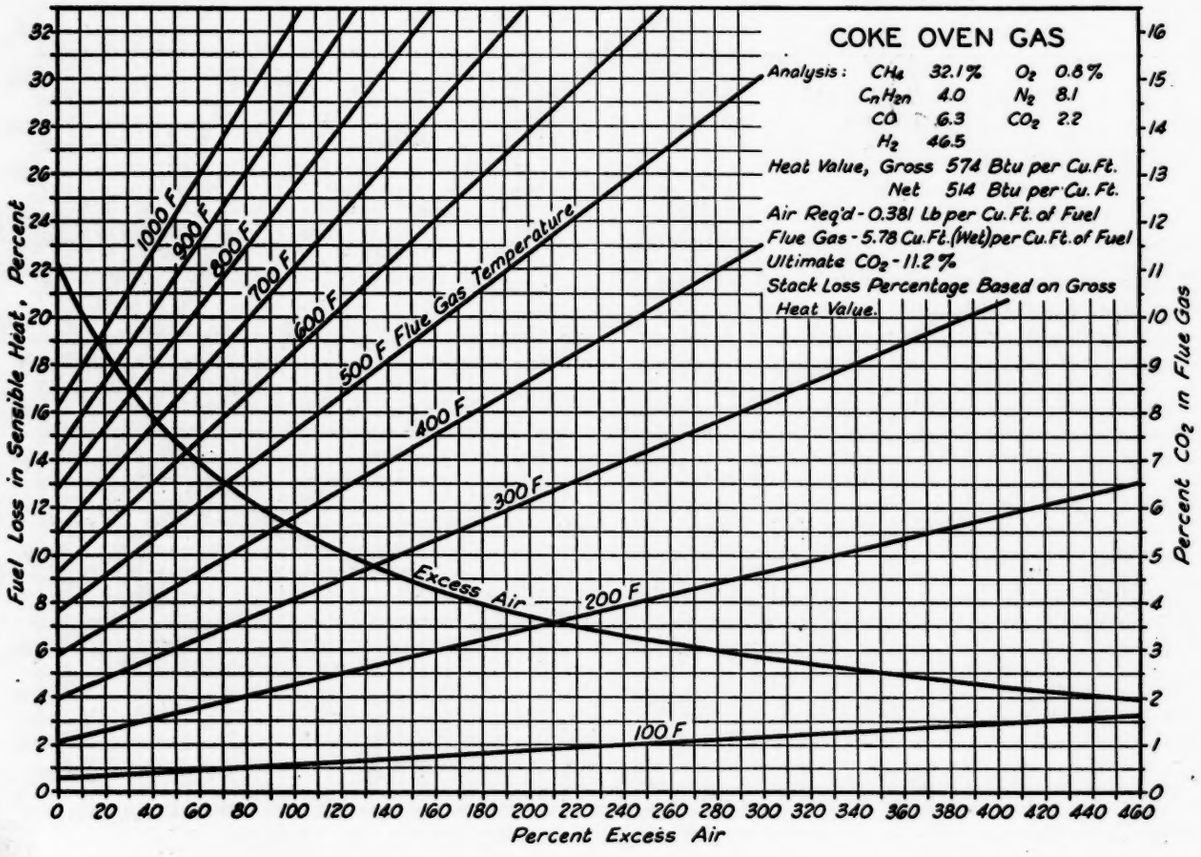
The accompanying charts are for determining the amount of excess air and the percent of sensible heat loss in the flue gas knowing the percent of CO_2 in the flue gas. The use of the charts is as described in the February, 1949 data sheet.


WOOD
(White Pine)
Analysis: C 52.55% H 6.08%
O 41.25 Ash 0.12
Heat Value, Gross 8176 Btu per Lb
Net 7630 Btu per Lb
(27 Lb per Cu. Ft. Air Dried)
Air Req'd - 6.34 Lb per Lb of Fuel
Flue Gas - 93.78 Cu. Ft. (Wet) per Lb of Fuel
Ultimate CO_2 - 20.06%
Stack Loss Percentage Based on Gross Heat Value.
1000 F
900 F
800 F
700 F
600 F
500 F Flue Gas Temperature
400 F
300 F
200 F
100 F
Excess Air
Fuel Loss in Sensible Heat, Percent
Percent CO_2 in Flue Gas
Percent Excess Air



HEAT LOSS IN FLUE GAS — MANUFACTURED GASES


OIL GAS
Analysis: CH_4 26.6 % O_2 0.3 %
C_nH_{2n} 3.7 N_2 4.9
CO 10.6 H_2O 1.7
H_2 49.2 CO_2 3.0
Heat Value, Gross 549 Btu per Cu. Ft.
Net 490 Btu per Cu. Ft.
Air Req'd - 0.366 Lb per Cu. Ft. of Fuel
Flue Gas - 5.505 Cu. Ft. (Wet) per Cu. Ft. of Fuel
Ultimate CO_2 - 11.92 %
Stack Loss Percentage Based on Gross Heat Value.
1000 F
900 F
800 F
700 F
600 F
500 F Flue Gas Temperature
400 F
300 F
200 F
100 F
Excess Air
Fuel Loss in Sensible Heat, Percent
Percent CO_2 in Flue Gas
Percent Excess Air


COKE OVEN GAS
Analysis: CH_4 32.1 % O_2 0.8 %
C_nH_{2n} 4.0 N_2 8.1
CO 6.3 CO_2 2.2
H_2 46.5
Heat Value, Gross 574 Btu per Cu. Ft.
Net 514 Btu per Cu. Ft.
Air Req'd - 0.381 Lb per Cu. Ft. of Fuel
Flue Gas - 5.78 Cu. Ft. (Wet) per Cu. Ft. of Fuel
Ultimate CO_2 - 11.2 %
Stack Loss Percentage Based on Gross Heat Value.
1000 F
900 F
800 F
700 F
600 F
500 F Flue Gas Temperature
400 F
300 F
200 F
100 F
Excess Air
Fuel Loss in Sensible Heat, Percent
Percent CO_2 in Flue Gas
Percent Excess Air

Effect of Specific Gravity on Ventilation Technique

JOHN D. CONSTANCE, P. E.

Placing of fans, design of ducts, cost of equipment, and effectiveness of ventilation, all depend on relative weight of the materials handled by ventilating equipment.

THE best method of preventing fires and explosions from combustible gases and vapors in a plant is to remove the dangerous gas or vapor from the space as quickly as possible. This may be accomplished by an efficient system of ventilation. The behavior and nature of gases must be understood, however, if a correct means is to be adopted for their removal.

There is no one method of ventilation suitable to all cases and all gases. The means adopted to remove dangerous gases must be in accordance with the nature of the gas in question and the ratio of the weight of a given volume of the gas to the weight of an equal volume of dry air measured at the same pressure and temperature. This ratio is what is commonly known as specific gravity. The ventilation of a room containing dangerously noxious or combustible gases may be effected either from ceiling level or floor level. The majority of gases or vapors present in industry are heavier than air and have specific gravities greater than unity with respect to dry air. Such gases or vapors will tend to sink to the floor. In such cases it would be incorrect to attempt to use a ventilating unit working at a higher level. Therefore, floor ventilation becomes imperative. On the other hand, ventilation at the ceiling may be applied in the case of lighter gases and vapors having specific gravities less than unity. Whether an explosion-proof, motor-driven fan in the roof will suffice to remove heavy gases from a space depends on the room size and ceiling height. When this system is used with small rooms having low ceilings the resulting draft would make the room uninhabitable. For heavy vapors a small ventilator of the simplest kind placed on the floor would be far more efficient than a powerful ventilator on the roof. With light gases (specific gravity less than 1.0) the conditions are naturally reversed. A small ventilator on the roof drawing the vapors from the ceiling would be superior to a larger one at the floor line.

The greatest difficulty encountered in the removal of gases is when their specific gravities approximate that of air, ranging 0.9 to 1.1 specific gravity. In such cases it is best to set up a powerful motor-driven ventilating fan in such a position that it can act directly at the point of generation and remove the gases as once. When a condition arises wherein several gases or vapors become mixed in the same room then the specific gravity of the mixture must be determined.

In order to facilitate the solution of the general problem of comparative advantages of roof and floor ventilation, Table 1 has been compiled listing specific gravities, chemical formulas, and molecular weights of gases. It would be helpful to keep in mind the fact that, due to various concentrations of its component gases, dry air molecular weights vary from 28.8 to 28.967. Third place decimal accuracy is not warranted for the application at hand and thus has been eliminated in certain spots.

Calculation of Specific Gravity. The determination of specific gravity is very important as may be appreciated from the foregoing. As far as a pure gas or vapor is concerned all that is required is to first determine its molecular weight and then divide by the mo[illegible]ec-

TABLE 1—SPECIFIC GRAVITY OF GASES AND VAPORS
(Dry Air = 1)

Specific Gravity	Fluid	Formula	Molecular Weight
0.069	Hydrogen (g)[1]	(H_2)	2
0.40-0.60	Coal gas (g)	—	—
0.510	Water gas	—	—
0.553	Firedamp (g)	—	—
0.553	Methane (g)	(CH_4)	16
0.588	Ammonia (g)	(NH_3)	17
0.622	Water vapor (v)	(H_2O)	18
0.71	Natural gas (g)	—	—
0.898	Acetylene (g)	(C_2H_2)	26
0.945	Hydrocyanic acid (g)	(HCN)	27
0.96	Carbon monoxide (g)	(CO)	28
0.967	Ethylene (g)	(C_2H_4)	28
0.97	Refinery gas	—	—
0.830-1.0	Generator gas (g)	—	—
1.0	Blast furnace gas (g)	—	—
1.036	Ethane (g)	(C_2H_6)	30
1.039	Nitric oxide (g)	(NO)	30
1.105	Oxygen (g)	(O_2)	32
1.120	Methyl alcohol (v)	(CH_3OH)	32
1.17	Hydrogen sulfide (g)	(H_2S)	34
1.520	Propane (g)	(C_3H_8)	44
1.52	Carbon dioxide (g)	(CO_2)	44
1.613	Ethyl alcohol (v)	(C_2H_5OH)	46
1.617	Methyl ether (g)	(C_2H_6O)	46
1.65	Gasoline (v)	—	—
1.738	Methyl chloride (g)	(CH_3CL)	50.5
1.80	Cyanogen (g)	(C_2N_2)	52
1.935	Butylene (g)	(C_4H_8)	56
2.004	Butane (g)	(C_4H_{10})	58
2.448	Chlorine (g)	(Cl_2)	71
2.56	Ether (v)	($CH_3CH_2OCH_2CH_3$)	74
2.62	Carbon disulfide (v)	(CS_2)	76
2.69	Benzene (v)	(C_6H_6)	78
3.41	Phosgene (g)	($OCCCl_2$)	111
4.11	Chloroform (v)	($CHCl_3$)	119.5

Where no formula is shown, specific gravity has been determined analytically.
[1](g) indicates gas; (v) indicates vapor.

TABLE 2—ATOMIC WEIGHTS OF COMMON ELEMENTS IN GASES

Element	Symbol	Atomic Weight
Carbon	C	12
Hydrogen	H	1
Oxygen	O	16
Nitrogen	N	14
Chlorine	Cl	35.5
Sulfur	S	32

ular weight of dry air. Thus, for ammonia having a molecular weight of 17, the specific gravity would be determined by

$$\frac{17}{28.967} = 0.588$$

Table 2 gives atomic weights of the components of those compounds in Table 1. For information on the more complicated compounds reference should be made to a standard text on chemistry.

Where a mixture of chemically non-reactive gases is involved and the volumetric analysis is not known the specific gravity may be determined directly using any one of several approved tests. However, if the analysis is known, calculation of specific gravity may be carried out in the following manner:

Example: A gas mixture has the composition by volume shown in Table 3. Determine the specific gravity of the mixture relative to dry air.

Since the definition of pound mol is the molecular weight of a compound expressed in pounds, and one pound mol of this mixture would weigh 12.746 pounds, the average molecular weight of the mixture is 12.746.

TABLE 3—COMPOSITION OF A GAS MIXTURE

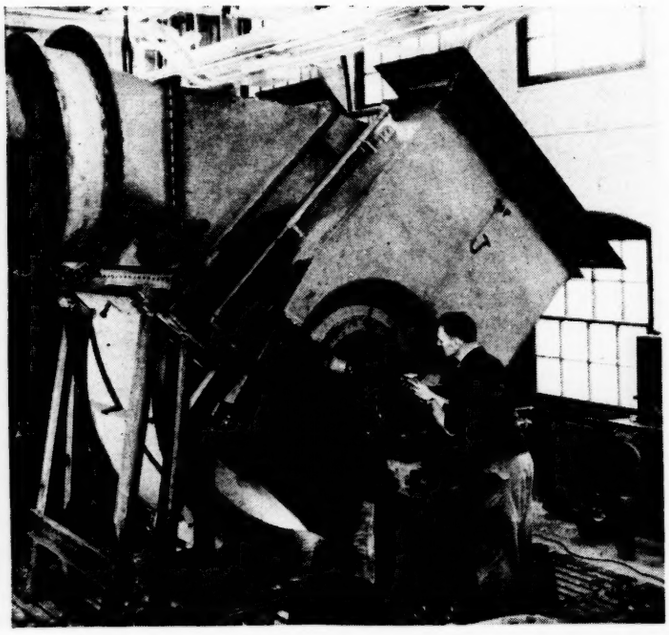
Components	Composition, % by volume	Molecular weight	Mol fraction	Pounds in 1 mol
CO_2	2.4	44	0.024	1.056
C_2H_4	3.0	28	0.030	0.840
C_6H_6	0.1	78	0.001	0.078
O_2	0.8	32	0.008	0.256
CO	7.4	28	0.074	2.072
H_2	48.0	2	0.48	0.960
CH_4	27.0	16	0.27	4.320
N_2	11.3	28	0.113	3.164
Total	100		1.000	12.746 lb.

The specific gravity desired is $\frac{12.746}{28.967} = 0.441$.

Volume fraction and mol fraction are identical and interchangeable. If water vapor is present in the analysis, the same method would determine the new specific gravity.

The specialized problem of duct and exhaust intake design is not covered here since it has been covered adequately in the literature. However, it should be noted that the closer to the point of generation an exhaust intake is located, the less air it will have to handle to accomplish the desired results. This consideration will not only be reflected in lower equipment costs, but, where winter ventilation is concerned, heating costs will be lower. In this respect it will be convenient to remember that, for each 1,000 cfm of air drawn into the space for ventilation and exhausted, one pound of steam per hour at ordinary heating pressure is condensed in the heating unit for each degree difference between inside and outside air temperatures.

Centrifugal Compressors to Cool Brookhaven Atomic Pile



Westinghouse centrifugal compressors will be used to cool the atomic pile under construction at the Brookhaven National Laboratory, Upton, N. Y. These units have already been shipped from the Sturtevant Division plant where they were designed and manufactured.

Balanced Wheel

The heart of each of the 12-ft high giant air movers is the nine-bladed, 3½-ft diameter, all-steel wheel. The nine forged steel blades are welded to a solid hub resulting in a rigid, homogeneous structure. The wheel is statically and dynamically balanced prior to assembly.

The compressors are of the double inlet type designed and built to handle air and gases at high temperatures. A 1,500-hp motor drives the wheel at a rim speed of 450 mph.

One of the big blowers that will cool the atomic pile is shown at left undergoing performance tests at the plant of the Sturtevant Division.

Comments Regarding the

Use and Installation of Convectors

NATHAN N. WOLPERT
Associate Editor, Heating and Ventilating

Findings of a survey made to determine opinions regarding preference for certain types of convectors, and practices relating to the installation of convectors.

TO obtain some concept of how convectors are being used and the preference of engineers and contractors for various types of convectors, one thousand readers were queried regarding the eight questions presented in the box on this page. As every effort was made to obtain a true cross-section of the heating industry, the comments received and the summation of the findings should have considerable value.

It is always interesting to learn of the opinions and practices of others in the heating field to check against individual thinking and methods of operation.

Opinions Regarding Convectors

Of those who expressed an opinion regarding the use of convectors, 28% mentioned that they considered convectors satisfactory; 11.7% said they preferred them to cast iron radiation; 10% installed convectors unless requested otherwise; 10% believed that convectors were superseding cast iron radiators; 8.3% considered them the most effective method of heating; 5% believed that convectors were overrated; 3.3% that convectors are more expensive than cast iron radiators. Following are some of the comments:

Heating Engineer, Moline, Ill.: A convector is the most responsive, the least space-occupying unit per square foot of radiation, the simplest to install but not necessarily the cheapest installation.

Owner, Contracting Company, Springfield, Ill.: We find that convectors will in no way compare with the advantages of baseboard radiation, owing to the fact that convectors have a tendency of streaking the walls, particularly the full recess type. It is much more difficult for a housewife to clean convectors than baseboard.

Mechanical Engineer, North Charleston, S. C.: Convector heating on the whole is slower and less direct than cast iron radiation due to its greatly reduced radiant effect. It is a little more expensive to install.

Estimator, Heating Company, St. Louis, Mo.: I believe it is the ideal unit in the competitive field.

President, Heating Company, Norfolk, Va.: I firmly believe that convectors will eventually replace cast iron radiators in domestic heating installations.

Engineer, Detroit, Mich.: We have used them extensively. We have used them for years without much maintenance and, besides, they are much more flexible.

Consulting Engineer, New York, N. Y.: We do not believe in the use of convectors because they are unsanitary, difficult to clean, and they are non-heat retaining.

President, Heating Company, Louisville, Ky.: While not as good as cast iron radiators, they look better.

Engineer, Detroit, Mich.: Considering cost, they are the best method of radiator heating.

Treasurer, Engineering Company, New York, N. Y.: We believe that convectors will replace cast iron radiators.

Factory representative, Missoula, Mont.: I have sold and installed them, and I believe that they are superior to all other types of radiators.

Design Supervisor, Seattle, Wash.: We believe convectors are definitely superseding cast iron radiators for all applications because of their better appearance, ease of installation and greater heating efficiency.

Consulting Engineer, Seattle, Wash.: We do not install cast iron radiators unless requested to do so by the building owner.

Here Are the Questions Asked

1. What is your opinion regarding convectors?
2. Which type of convectors do you prefer, and why?
   a. Copper tube and non-ferrous fins
   b. Steel tube and steel fins
   c. Cast iron body with cast iron fins
3. In specifying non-ferrous convectors, check by number the order preference, as 1, 2, 3, etc., the factors influencing your selection—efficiency, cost, appearance, ease of control, ease of installation, low cost of maintenance and decoration.
4. Approximately what per cent of your convector installations are hot water; what per cent steam?
5. Approximately what per cent of your convector installations are recessed; what per cent free standing?
6. Do you favor automatic air vents for hot water convectors? Why?
7. In the modernization of old heating systems, do you recommend convectors as replacements for obsolete equipment? Why?
8. What is your opinion regarding the installation of convectors and radiators in one system?

TABLE 1—DISTRIBUTION OF CONVECTORS IN HOT WATER AND STEAM SYSTEMS

Hot Water, %	100	95	90	85	80	75	70	65	60	50	40	35	30	25	20	15	10	5	0
Steam, %	0	5	10	15	20	25	30	35	40	50	60	65	70	75	80	85	90	95	100
Per cent of readers indicating such division of their convector installations	9.0	5.0	18.0	1.2	8.0	5.0	4.0	1.2	1.2	11.0	1.2	1.2	2.4	5.0	1.2	2.4	8.0	5.0	10.0

Consulting Engineer, Des Moines, Iowa: We are using convectors in most of our work.

Type Convectors Preferred

Three types of convectors were mentioned for the readers to indicate their preference and to indicate why they chose the type indicated. Copper tube and non-ferrous fin type was preferred by 75%; steel tube and steel fins, 11.5%; cast iron body with cast iron fins, 13.5%. Some of the reasons for individual preference are given in the following comments:

Engineer, Seattle, Wash.: Copper is preferred mainly because of the ease of installation. However, the types we use are selected to best fit the application. Cast iron does not need the frequency of cleaning that the finned types require.

Construction Engineer, Baltimore, Md.: As a larger number of manufacturers make copper tube as against steel, it is cheaper, easier to procure, and it is made in a greater variety of sizes.

Chief Engineer, Boston, Mass.: Type *a* mentioned in Question 2 is light in weight, is easy to handle and is cheap; *b* is best for baseboard convector heating; *c* is good but is too expensive.

Heating Contractor, Kewanee, Ill.: Cast iron retains heat and is easier to control. It does not result in periods of "too-hot" or "too-cold" as with copper convectors.

Heating Contractor, New York, N. Y.: Copper tube heats quicker in hot water systems; cast iron convectors in steam systems retain the heat longer.

Heating Contractor, Bethesda, Md.: Cast iron holds the heat for a longer period of time. This model will not clog with dust as do other types.

Factors Influencing Selection

Six factors were mentioned that might influence one to specify non-ferrous convectors. Readers were asked to place these items in the order of their importance to them—efficiency, cost, appearance, ease of control, ease of installation, and low cost of maintenance and decoration.

In presenting the findings for this question, it was necessary to depart from the straight percentage basis. An item that was marked (1) was given six points, if marked (6), one point, with suitable points for listings between the two. Following is a composite selection based on all the answers to this question, and utilizing the weighted point system for grading:

(1) Appearance
(2) Cost
(3) Efficiency, and ease of installation
(4) Low cost of maintenance and decoration
(5) Ease of control

Efficiency, and ease of installation came so close in the grading, that for practical purposes, they are considered as receiving equal weight.

Type of Installations

As to what percentage of the convector installations were hot water and what percentage steam, 9% indicated that *all* their convector installations were for hot water; 10% that all installations were for steam. For a complete analysis of the per cent of readers reporting definite distribution of convectors in hot water and steam systems, see Table 1. Analysis of the replies to the question relating to the per cent of convector installations that are recessed, and the per cent free-standing, is given in Table 2.

Automatic Air Vents

Replies to Question 6 indicated that 67.5% were in favor of using automatic air vents with hot water convectors. As indicated by some of the following comments, the automatic air vents avoid the need to remove parts of the convector cabinet in order to vent the convector by manual means, and they also assure that service calls due to air-bound convectors will be eliminated.

Contractor, Detroit, Mich.: We are not sure enough of their freedom from leakage.

Contractor, Torrington, Conn.: I have not as yet found a reliable small automatic air vent.

TABLE 2—TYPE OF CONVECTORS INSTALLED

Recessed, %	100	95	90	80	75	70	65	60	50	40	30	25	20	15	10	5	0
Free-Standing, %	0	5	10	20	25	30	35	40	50	60	70	75	80	85	90	95	100
Per cent of readers indicating such division of their convector installations	7.7	1.3	15.0	1.2	5.2	2.4	1.3	3.9	22.0	3.9	5.2	3.9	5.2	1.3	10.2	3.9	6.4

Heating Engineer, Chicago, Ill.: I believe they are very necessary and eliminate service calls to take the air out of a convector that does not operate well.

Contractor, Wellesley, Mass.: We have found that the non-ferrous type convector especially requires frequent venting and that the covers are sometimes cumbersome to replace.

Heating Contractor, Kewanee, Ill.: Automatic venting is preferred over hand venting as venting becomes difficult when one has to remove the grille from each convector.

Contractor, Pittsburgh, Pa.: I favor automatic venting. In residences, owners will not vent radiators and in other types of buildings, what is everybody's business is no one's business.

Engineer, Merchantville, N. J.: Automatic vents are favored for they prevent sluggishness at the point where it is possible for air to accumulate.

Consulting Engineer, Bernardsville, N. J.: Automatic air vents and air eliminators, properly located in the system, provide dependable circulation at all times, prevent air locks and maintenance worries, especially in radiant panel heating or high temperature industrial hot water process heating.

Engineer, Detroit, Mich.: Automatic air vents are favored, for maintenance men neglect to vent unless the convectors are completely air-bound.

Mechanical Engineer, Omaha, Neb.: Prefer not to use automatic vents except as a precautionary measure to prevent air lock.

Chief Engineer, Arlington, Mass.: Occupants fail to keep units properly vented where manual vents are used.

Building Service Engineer, Boston, Mass.: I favor automatic vents when used on up-feed systems to permit removal of air which could not otherwise escape. I do not favor them where air can rise to an expansion tank.

Engineer, Norfolk, Va.: They are often cheaper than manual vent assemblies and they require less servicing.

Design Supervisor, Seattle, Wash.: Automatic air vents are favored. Convectors do not have the air-retaining capacity of radiators and therefore need more frequent venting. Air-bound convectors are our biggest source of trouble in owners' maintenance procedures.

Construction Engineer, Baltimore, Md.: We like automatic vents for they tend to make a system more automatic and results in better operating conditions and less bother to the home owner.

Replacements

In the modernization of old heating systems, 72% recommended convectors as replacements for old equipment. Chief reasons given were appearance, and the fact that less space was required for convectors. Following are some of the comments received to this question.

Heating Contractor, Klamath Falls, Ore.: Convectors are recommended for replacements for they are better looking, are cheaper to install, and have better possibilities for recessing.

Consulting Engineer, Seattle, Wash.: Yes. Convectors have a better appearance, require less labor, and provide a cleaner job in all respects.

Chief Engineer, Office Building, Chicago, Ill.: Convectors are recommended for replacements for their appearance, the labor-saving resulting from less cleaning, and because they occupy less space.

President, Supply Company, Louisville, Ky.: Convectors are not recommended. We like cast iron radiation.

Heating Engineer, Chicago, Ill.: Convectors make the system look well and they are very fast to respond to temperature change.

Architect, Mannette, Wis.: Convectors cannot be put on the same piping as cast iron and are not good on one-pipe jobs.

Heating Contractor, Kewanee, Ill.: Convectors are recommended for they do not cost much more than radiators, and they are more efficient and better looking than radiators.

Heating Engineer, Worcester, Mass.: Cast iron convectors are recommended.

Consulting Engineer, Manchester, N. H.: If the owner can afford to replace the existing radiators because they are too small or unsightly, convectors are cheaper, smaller and look better.

Heating Contractor, Torrington, Conn.: I prefer actual radiation from a warm mass of iron. In homes, convectors are too dusty.

Consulting Engineer, Des Moines, Iowa: For a complete remodeling, we often call for convectors to reduce cost and to follow the modern trend.

Convectors and Radiators

No question in this group brought forth as much comment as the one relating to the use of convectors and radiators in one heating system. Of those replying, 59% indicated that they were against such a practice and 41% were for it. However, of this 41%, 5.9% said that they were in favor providing the system was zoned; 8.8% were for it if the radiators were individually controlled; 14.7% approved if cast iron convectors were used with the cast iron radiators. Therefore, if those who replied with reservations were considered as negative, the readers against the practice of mixing convectors and radiators would total 71%.

The comments received give both sides of this picture and indicate some of the good and bad results that have been experienced.

Sales Engineer, Richmond, Va.: In the case of constant steam pressure or continuous circulation of hot water, the mixing of responsive convectors and non-responsive cast iron radiators is all right. With intermittent steam supply or hot water circulating pump operation, the practice is to be discouraged because the factor of thermostat location presents too great a problem for any possible saving.

Heating Engineer, Albany, N. Y.: This does not work out if they are mixed and operate under one thermostat. It results in unbalanced heat. Convectors and radiators can be mixed with cast iron radiators operating under its own thermostat and convectors controlled by another.

Design Supervisor, Seattle, Wash.: We do not mix

convectors and radiators in the same system. However, if it is necessary to do so, we use cast iron elements so that the heat-retaining capacity of the convectors and radiators will be as nearly equal as possible.

Consulting Engineer, Bernardsville, N. J.: Do not combine for the comfort levels vary too greatly. Use either all radiators or all convectors. Much difficulty is experienced in hot water systems especially, due to difference in circulating head required and absence of radiant effect at convectors.

Consulting Engineer, Manchester, N. H.: It is perfectly all right, contrary to the opinion of practically all plumbers and steamfitters. I have done it successfully with due regard to proper proportioning and sizing with modifications or extensions of existing systems.

Consulting Engineer, Washington, D. C.: Convectors and radiators result in an unbalanced water flow. More water must be placed in the system and this calls for larger expansion tanks. However, this office always specifies radiators in bath rooms and kitchens, and semi-recessed convectors in living spaces, for small convectors cost more than radiators and bath rooms and kitchens represent small heating loads. Use plug cocks to balance the returns.

Mechanical Engineer, Merchantville, N. J.: This is satisfactory providing the system is zoned and only convectors or radiators are in distinctive zones. Otherwise it would be preferable to use only cast iron convectors in the system.

Engineer, Manchester, N. H.: I am definitely against this. The cycle of heat output is different and it is almost impossible to maintain even heat with cast iron and copper on the same system.

President, Heating Company, Norfolk, Va.: Our office finds no advantage in this type of installation. We carry a higher boiler temperature for convectors than radiators.

Chief Engineer, Boston, Mass.: If you prefer to use cast iron radiators and copper convectors, we do not recommend that they be mixed in the same zone. Cast iron radiators and steel pipe and steel finned baseboard radiation seem to function together and balance out to an even temperature.

Building Service Engineer, Boston, Mass.: With small or moderate size systems supplied from a small central boiler, I believe it is preferable not to mix convectors and radiators. On large systems, such as ordinarily occur in industrial plants, I do not believe there is any objection to this.

Engineer, Cleveland, Ohio: If the two heat sources are on the same controlled steam lines, I would go to all radiators or all convectors because of the difference in lag between cast iron radiators and non-ferrous convectors.

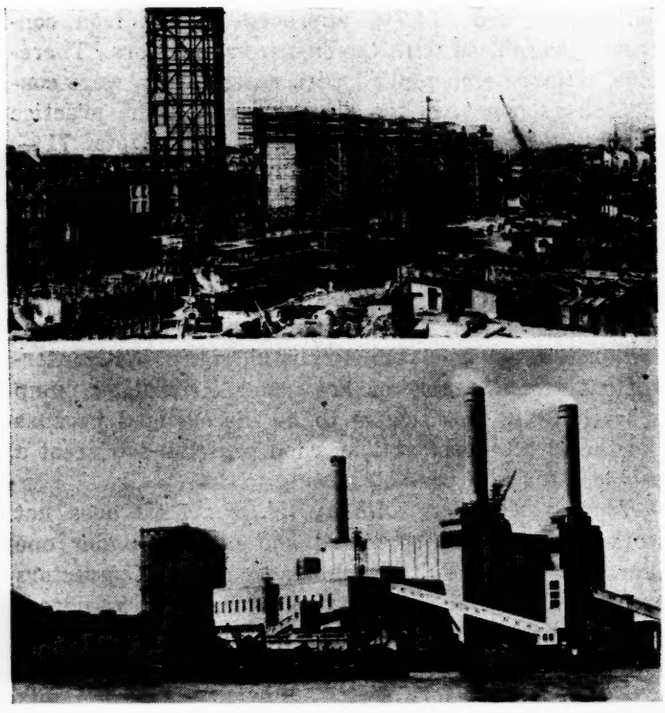
Consulting Engineer, North Charleston, S. C.: They all work fine. I have done this on several jobs where the appearance of cast iron radiators is not objectionable. For example, I have placed radiators in shops—convectors in showrooms and offices.

Sales Engineer, Charleston, W. Va.: Never install convectors with cast iron radiators in one system if they are to function from the same control. It would be all right to use cast iron radiators and convectors on the same control if an outside-inside control is used.

Owner, Home Maintenance, Scotch Plains, N. J.: We find it creates an unbalanced system. Radiators will hold the heat much longer so that the room with convectors will cool faster than those served by radiators.

Consulting Engineer, Peoria, Ill.: If zone controlled, they should be on separate zones. If individual control is used, the two can be mixed.

Power Plant Heats London Housing Project



Exhaust heat from a power plant will be used to heat and supply domestic hot water to the Pimlico housing project being completed in London, England. Heat generated at the Battersea Power Plant will be transmitted under the River Thames and stored in a large heat accumulator for the apartments. This housing project is located in the Westminster precinct of London.

The accumulator will tower in height above the apartment buildings that it will serve.

(Upper)—Construction of one of the first blocks of apartments of the Pimlico housing project, London, England. The heat accumulator is shown at the left of the photograph. (Lower)—Battersea generating plant that will supply heat and domestic hot water to the apartment buildings on the opposite side of the River Thames.

Experience is my Classroom

By T. W. REYNOLDS

• AIRING IT OUT

Location of a pump near to or far from the boiler affects its operation in several ways. Remoteness from the boiler adds friction against which the pump discharges, and places the pump where it will have less convenient attention. Offsetting these disadvantages, however, are reduction in the extent of returns under suction, and consequently the number of points of air infiltration, and this, together with the lessened air volume in shorter returns, reduces the amount of air to be removed. Incidentally, a pump discharge line is of much smaller size than the portion of vacuum return line which it eliminates.

Another factor is that returns of magnitude should be handled by a so-called pumping unit, which in reality is two pumps, one for air and the other for condensate. As a boy I proudly owned a combination knife, cork screw, nail file, gimlet, and what not, but I do not recall that it performed any of its varied functions so well as a knife with a single purpose. In like manner, a pump does not work so well where it must handle both air and condensate, especially so as the quantity and temperature of each continually varies with respect to each other.

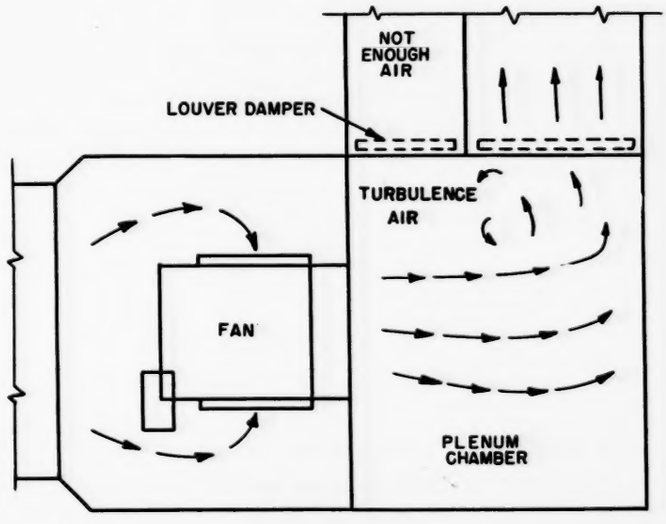
• PLENUM CHAMBER DESIGN

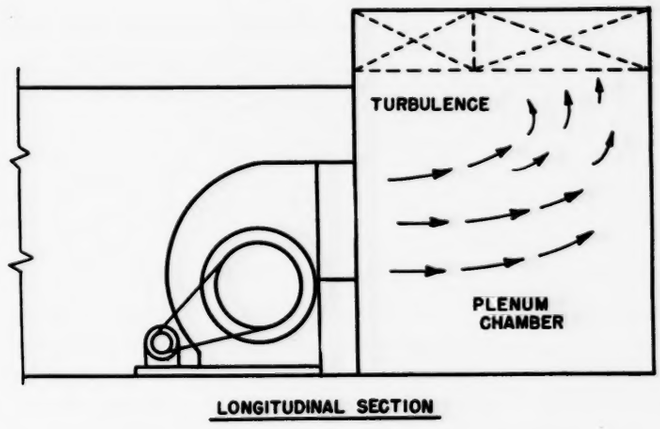
Pressure for conservation of space often becomes so great that one is restricted to the point where the plenum chamber becomes less of a plenum or pressure chamber and more of a velocity chamber or mere enlargement of a duct wherein there is some expansion and much turbulence, and therefore resistance. In a recent case, a rather restricted plenum chamber (see sketch) caused too much air to flow to the branch duct at the end of the chamber, leaving the branch nearest the fan with too little air and the area it served undercooled.

To meet such conditions, one often depends upon a louver type damper in each branch duct as a hopeful correction and it often is. Even with a true plenum chamber, such dampers are advisable to overcome the difference in location of branch duct outlets, greater number of abrupt turns in some branch immediately upon leaving the chamber, or greater duct resistance of one duct over the other. In the case shown the near branch outlet is too close horizontally to the fan discharge, and there are no coils in the branch ducts to interpose resistance and more or less equalize the air flow over the face of each coil, as would be the case with zoned branch ducts.

In the August *Journal Section* of the American Society of Heating and Ventilating Engineers, one may find some interesting data on plenum chambers, together with a proposed cone at the fan discharge to free the chamber of turbulence and thereby reduce resistance and also equalize the air flow to branch outlets. While these data point the way, the writer wonders whether the findings would not have varied somewhat had the test chamber been a true plenum chamber instead of an enlarged duct serving only as an expansion chamber; furthermore, the chamber expands only horizontally each side of the fan discharge and not vertically above and below.

The paper referred to seems to assume that the test chamber is the usual plenum chamber and also that an





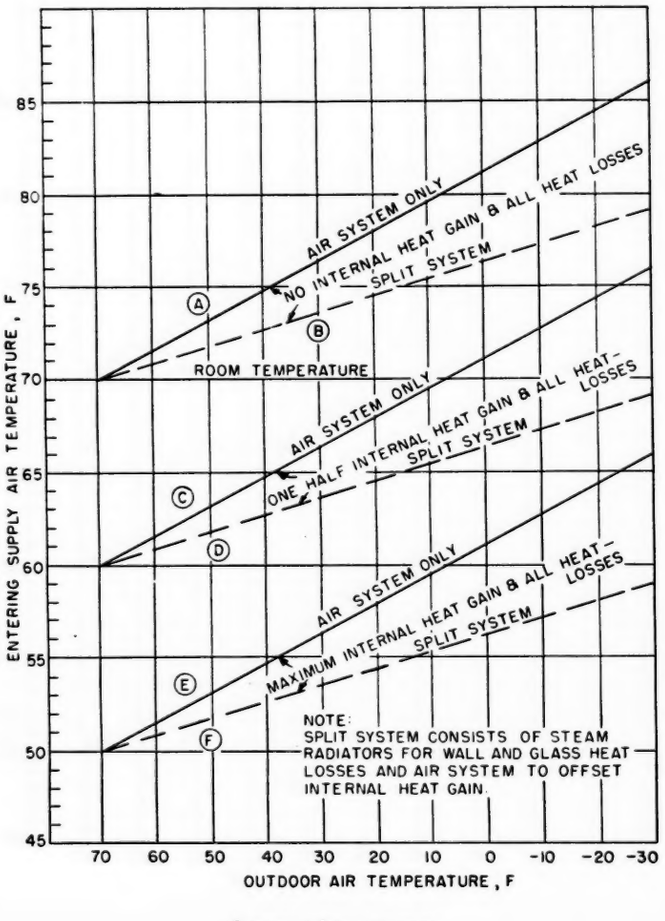
An expansion chamber, not a true plenum chamber.

expansion chamber is a plenum chamber, although all of the plenum chambers I have ever encountered have been ones you could walk around in. Now, a plenum chamber is also an expansion chamber, but an expansion chamber is not necessarily a plenum chamber. A true plenum chamber, unless the nomenclature has become distorted with time, is one in which the fan discharge velocity is so expanded in an enlarged area that most velocity energy is converted into static pressure.

The cone shown with the test data is only a cone horizontally. For the usual chamber it should be a cone in all directions constructed somewhat as a ceiling diffuser. Possibly the writer has gone astray somewhere on his reasoning or interpretation of the tests, but, in any event, the foregoing is contributed as a thought should further research be conducted on plenum chambers.

• LARGE GLASS AREAS

Large outside glass windows in restaurants enable one to see everything and to feel everything when sitting close; in the winter body radiation to glass, drafts down the glass or from air infiltration, and radiation from the sun. The last may be annoying both winter and summer. Double glass may minimize, though not eliminate annoyances. Special treatment or zoning of the window areas is required. Intermittent heating, as with steam radiators, is not desirable. Continuously circulated hot water of regulated temperature in the radiators, or zoned air outlets directly below or at the windows are necessary.



Large glass areas.

Where there is a split system (conditioned air from ceiling outlets and steam to window radiators), regulation by thermostat or manually is often such that the air system does all of the heating or cooling with radiators standing idle most of the time. Such operation causes chilled window areas, especially so where one's legs become crowded too close to cold metal of radiator enclosures. Even when steam is in the radiators, it seldom travels their full length, especially where these are over capacity, or over-long, as in fin-type pipe radiators.

As the restaurant is about to open up for the day's business, quicker heating can be obtained by filling the conditioned space with the warmed air of recirculation (using only the air system) then, as employees enter, limited ventilation may be desired. The only difficulty with this all-air method is the complaints of the employees and first few customers about hot blasts on their heads, a typical condition being the curve *A* in the accompanying graphs for an actual installation. This discomfort of too hot air is worse than shown when initial heating is accelerated above the graph temperatures, but may be eliminated by heating jointly with air and radiators (curve *B*). Heating-up period, however, will be somewhat lengthened.

As the restaurant becomes more occupied, say 50%, the entering air must drop below the usual 60F, and when this proves too uncomfortable, there is a tendency of the operator to keep the temperatures up by not supplying steam to the radiators (see curve *E*), but this gets one back again to uncomfortable conditions along the windows.

Referring to the graphs, note that coincident with the restaurant opening for the day, there is no heat gain. At this time, the entering supply air temperature will have to be varied in accordance with the outdoor temperature and the mode of operation, whether the air conditioning system is operated, or both air and radiator systems jointly. When both systems are jointly operated, the air system takes care of the roof heat losses and the radiator system the remaining heat losses of wall and glass.

As the outdoor temperature lowers, the supply air temperature will climb progressively upward from 70F room temperature, or some temperature below 70F, dependent upon whether heating or cooling is required for the conditions of heat loss on the one hand, and the internal heat gain on the other hand. Starting up the restaurant with no appreciable internal heat load (lights or population) the entering air temperature will do heating only and rise as the outdoor air temperature drops, until at 30F below zero outdoors, the air temperature will be either 86F with just the air system operating, or 79F with both systems running. When, however, the restaurant becomes fully occupied and the internal heat gain is therefore at a maximum, the supply air has to do cooling only and be lower than before by 20F and, of course, for one-half the internal heat gain, the supply air would enter at only 10F lower, or 76F for the air system and 69F for the split system.

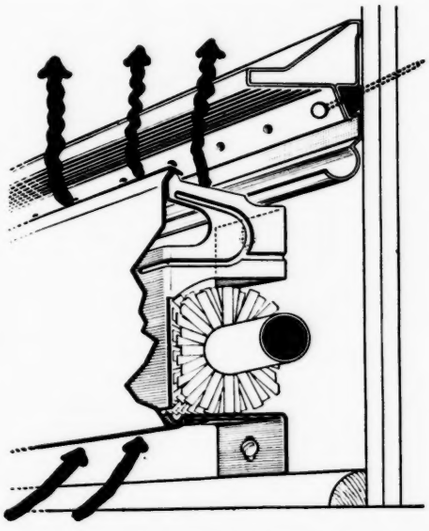
NEWS OF EQUIPMENT AND MATERIALS

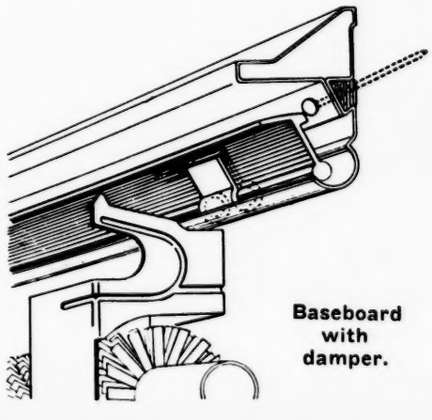
Webster Baseboard

NAME — New Webster Baseboard heating unit.

PURPOSE—Space heating.

FEATURES — The new baseboard heating is a patented forced hot water system in which the convector heating element fits behind a specially built metal baseboard. It is run in a continuous loop around the exposed walls of the house with a separate loop for each floor. The new baseboard is narrower, projecting only 2⅛ inches from the wall, and has an overall height of only 8¼ inches. Heating element is a ¾-inch copper tube with copper fin construction with the front and back edges of the finned elements flattened to reduce baseboard depth. A paper wrapping covers the heating element to protect the fins during installation. After the heating element has been placed, this cover is easily removed by means of a tab which is pulled off. Tab also acts as a guide to position the heating element. A heat damper (illustrated) is an optional feature. Damper is made of extruded magnesium alloy and is operated by a control knob. An extension on the rear of the metal molding forms the support for the damper. A one-piece bracket serves as hanger for the heating element and the front enclosure. A one-piece metal molding with sponge rubber seal strip is attached to the wall. The sponge rubber counteracts any unevenness of the wall so that dirt streaks caused by circulating air are avoided. This strip has holes punched at regular intervals to make it easy to nail this metal molding to the wall. Enclosure is of 18-gage steel supplied with a painted prime coat.





Baseboard with damper.

SIZES AND CAPACITIES — Available in type HNL, which has three fins per inch, and type HNS, which has five fins per inch. A Hi-Cap element is available with larger heat output. For the HNS type, capacity with 170F water is 380 Btu per ft of length; for the HNL type, with 170F water, 310 Btu.

MADE BY—*Warren Webster & Company, Camden, N. J.*

Item 401

M.S.A. Ventilator

NAME—M.S.A. belt-driven portable ventilator.

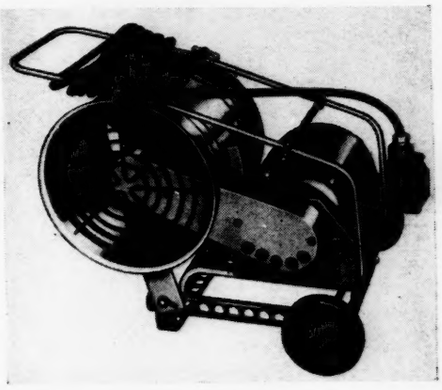
PURPOSE—Portable unit for cooling and ventilating engine rooms, storage tanks, refrigerator cars, and for exhausting gases and vapors.

FEATURES—Powered by a gasoline engine, air is conveyed through a 14-inch diameter, 16-ft-long canvas duct. Ducts are treated for flame and mildew resistance and when not used can be collapsed and folded into a compact bundle. Two-way air flow permits the duct to be connected to either the inlet or discharge side of the fan. Up to 32 feet of duct may be connected to this unit. The engine is a Briggs & Stratton unit, 1 cylinder, 4 cycles, 1.5 hp. Model can also be supplied with an explosion-proof motor operated on 115- or 230-volt, 60 cycles, a-c.

SIZES AND CAPACITIES—Air delivery with duct attached, 4,000 cfm. Total weight without duct, 86 lb.

LITERATURE AVAILABLE—Bulletin.

MADE BY—*Mine Safety Appliances Co., Braddock, Thomas and Meade Sts., Pittsburgh 8, Pa.*



Item 402

Barber-Colman Diffuser

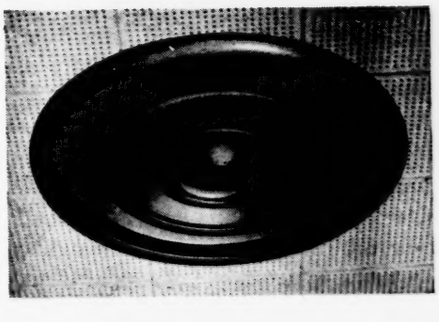
NAME — Venturi-Flo air outlets, models *J* and *JC*.

PURPOSE — Draftless air distribution and rapid temperature equalization through special air diffusers.

FEATURES—A screw at the center of the model *J* provides adjustment of air pattern from horizontal to vertical deflection. The model *JC* is a combination supply and return unit with key adjustment of the return air volume. It is similar in appearance to the model *J* and is said to be suitable for systems where the structure will not permit the installation of side wall outlets. Both types are available in a gray prime coat, baked metalescent aluminum, or a wide variety of electroplated finishes. Outlets are supplied in a variety of sizes.

MADE BY — *Barber-Colman Co., Rockford, Ill.*

Item 403



Greer Gage Cut-Out

NAME—Greer gage cut-out, model DV 15-200.

PURPOSE—An automatic device to protect gages in a multi-gage pressure system and to eliminate the need for manually shutting down each gage in the system when that gage is not used.

FEATURES—When installed the unit provides protection for the gage by automatically cutting it out of the circuit if the line pressure should suddenly rise above the safe operating range of the gage. The positive opening and closing action eliminates the use of a relief valve and shut-off valve for the gage. Replacement springs are available so that if the cut-out has to be used for a different pressure than that for which it was procured, it is only necessary to install the proper type spring. For intermediate pressures, an adjusting screw is provided in the body. Cut-out is made for standard pipe connections but can also be supplied with AN adapters for aircraft fittings.

SIZES AND CAPACITIES—Made in two series ranging from 30 to 300 lb per sq in. and a high pressure series ranging from 400 to 3,000 lb per sq in.

MADE BY—*Greer Hydraulics, Inc., 454 - 18th St., Brooklyn 15, N. Y.*

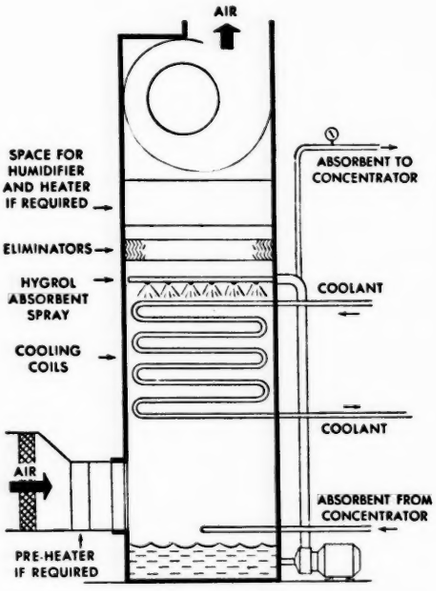
Item 404

Niagara Controlled Humidity

NAME — Niagara method of controlled humidity.

PURPOSE—System of air conditioning to provide complete control of temperature and relative humidity.

FEATURES — Apparatus is enclosed in a casing through which air is drawn by fans. This air is filtered and enters a chamber where it is dehumidified in passing through a spray of hygroscopic chemical termed "Hygrol". This spray absorbs the air-borne moisture. In the same chamber are located cooling coils which remove the latent heat of evaporation and any sensible heat that may be required. After the air stream passes through entrained moisture eliminators, it is diffused in the space to be conditioned. The spray falls into a tank at the base, from which it is piped to a concentrator that removes the excess moisture. The reconcentrated liquid is returned to the system and the cycle continues. Applications are generally in a temperature range from 35F up. Makers claim a condition of 15 grains of moisture per lb of air at 85F D.B. has been produced without refrigeration.



SIZES AND CAPACITIES—Made in a range of sizes providing from 1,000 to 20,000 cfm of conditioned air from a single unit.

MADE BY—*Niagara Blower Co., 405 Lexington Ave., New York 17, N. Y.*

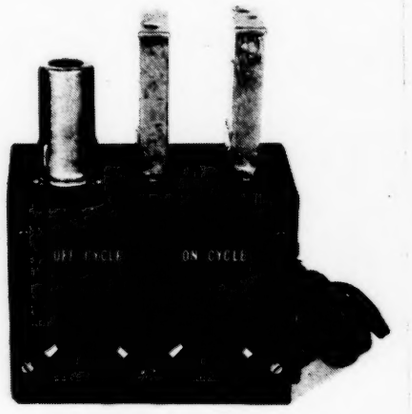
Item 405

Cyclo-Flex Timer

NAME—Cyclo-Flex timer.

PURPOSE—An electronic control device which may be operated with manual initiation or as a repeat cycle timer.

FEATURES—Each timing interval is accompanied by relay contact closure and is obtained by the charging of a resistance-capacitance network. Makers claim that timer intervals are virtually unaffected by variations in line voltage. To convert from single interval to repeat cycle operation requires only the rotation of the off-cycle control to the desired interval. Unit employs one radio type vacuum tube that operates on 110 to 125 volts, 60 cycles. The relay is a single pole, double throw with contacts rated at three amperes.



SIZES AND CAPACITIES—On time intervals, ½ to three seconds; off period, from nine to 20 seconds. Unit can be furnished with modification as to time intervals and contact ratings.

MADE BY—*G. C. Wilson & Co., 2 N. Passaic Ave., Chatham, N. J.*

Item 406

Fiberglas Insulation

NAME—Fiberglas PF pipe insulation, type 80.

PURPOSE—Molded pipe insulation to withstand temperatures up to 800F.

FEATURES — Product is made of glass fibers bonded by a thermosetting binder and molded in cylindrical form in all standard sizes up to 30 inches. It is available with a 4-oz canvas cover as a standard stock item. However, it can be supplied with a heavier canvas cover or with a 35-lb roofing felt jacket in place of canvas for use in locations where it would be subject to occasional wetting.

MADE BY — *Owens-Corning Fiberglas Corp., Toledo 1, Ohio.*

Item 407

Hi-Therm Air Conditioner

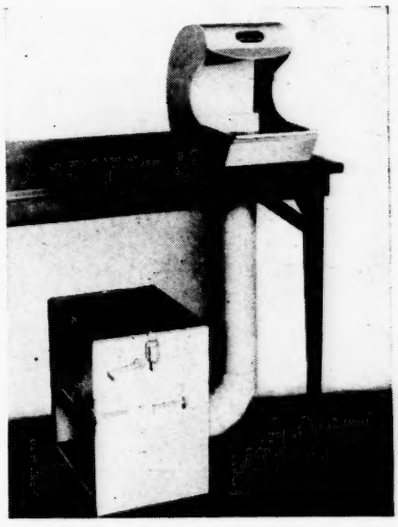
NAME—Hi-Therm.
PURPOSE — Warm air unit with steam or hot water boiler for space heating and supplying domestic hot water.

FEATURES—Unit is said to employ a new heating principle, a double incline fire pass intended to facilitate generation of steam from cold water in 12 minutes. The double incline fire pass uses 34 sq ft of boiler plate area to obtain maximum heat from the flue gas and to reduce stack temperatures. Steam unit will supply 3 gpm of domestic hot water. Steam that is generated in the split-unit rises to a copper finned radiator and the heat is then delivered to the ducts by a blower. The domestic hot water heating coil is immersed at all times in the heating body. A Petro electronic oil burner is used. Unit is packaged ready for firing with combustion chamber built in and all controls wired and mounted. Heating unit is enclosed by one inch of glass wool.
SIZES AND CAPACITIES—Rated at 90,000 Btu per hr, Model HT-S3 is for steam and HT-W3 for hot water. Unit measures 20 inches wide, 48 inches long, and 69 inches high.
MADE BY — *Petroleum Heat & Power Co., Stamford, Conn.*

Item 408

Dustkop Collector

NAME — Dustkop dust collector, model 331D.
PURPOSE—A small complete dust collector system intended for small grinding or polishing installations.
FEATURES—Unit is supplied with a bench top hood, sheet metal pipe and elbows so that an installation can be completed in a very short time. Suction is provided by a paddle-wheel fan direct driven by a ¼ hp motor. A special type dust separator plus a spun glass filter provide a two-stage means of air cleaning. A hand crank on the side of the unit is used for periodic shake-down of the filters. The collected dust is removed by a clean-out tray. The hood has a socket for a light bulb. Two removable trays, one for wet and the other for dry grinding, are supplied. Unit is fabricated of heavy gage steel.
SIZES AND CAPACITIES—Size 12 x 14 inches x 18 inches high. Available in various sizes from 250 to 3,600 cfm.

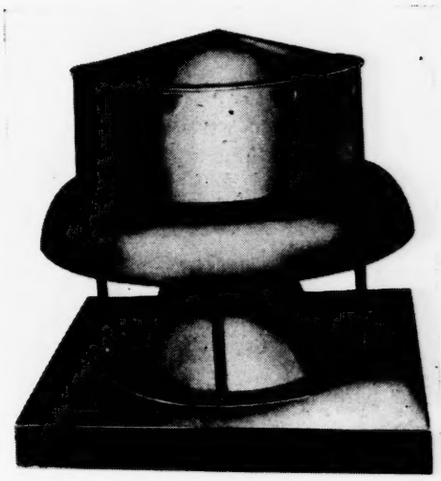


MADE BY—*Aget-Detroit Company, Ann Arbor, Mich.*

Item 409

Gallaher Air Exhauster

NAME—Gallaher Air Van.
PURPOSE—Air exhaust unit for roof installations.
FEATURES—Motor is enclosed and is placed out of the air stream, thereby eliminating corrosive action due to moisture or chemical fumes. Explosive danger is said to be eliminated. Motor is pancake type fitted with grease sealed, lifetime bearings. A squirrel cage fan is used with a blade design that results in a high, positive air expulsion. Unit is completely weatherproof. The air outlet is designed to prevent blow back even under adverse weather conditions. No back draft damper

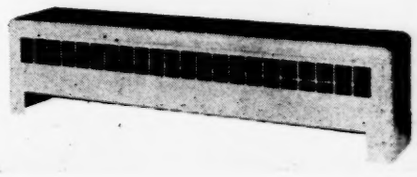


is required. If desired, unit can be furnished in special metals.
SIZES AND CAPACITIES—From 150 to 12,000 cfm.
MADE BY — *Gallaher Company, Omaha, Nebraska.*

Item 410

Trane Convector

NAME—Trane picture window convector.
PURPOSE — Convector-radiator designed to fit snugly under the large expanses of glass of a picture window.
FEATURES — Convectors are 12 inches high and are available as recessed or free-standing units. No dampers are available on these convectors. Inlet grilles are optional.
SIZES AND CAPACITIES—Available in



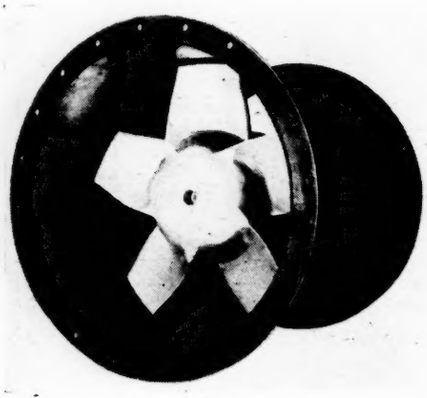
depths of 4, 6, 8 or 10 inches, and in lengths up to 88 inches. Capacities (steam) range from 5.5 to 64 sq ft EDR.
MADE BY—*The Trane Co., LaCrosse, Wis.*

Item 411

R & M Fans

NAME — Propellair direct driven tube axial fan, type CDD.

PURPOSE—Unit to supplement the belt driven tube axial type of fan.



FEATURES — Fully enclosed, sealed ball bearing motors are supplied as standard equipment and are mounted on welded cross supports in a heavy drum housing. Rolled angle flanges welded to the drum provide easy installation in standard duct systems or transition chambers. Where necessary, an explosion-proof or glass-insulated motor is available. Cast aluminum airfoil propellers are used, designed with a heavy cross-section area at the hub. Makers claim that this reduces the crystallization effects of pulsating loads inherent in most duct type installations. Fans are equipped with deep row ball bearings to permit operation in any position.

SIZES AND CAPACITIES — Available in diameters of 20, 24, 30, 36, and 42 inches; in ratings from ½ to 7½ hp; for capacities from 5,075 to 26,800 cfm.

MADE BY — *Propellair Division, Robbins & Myers, Inc., Dept. HV, Springfield, Ohio.*

Item 412

A-P Regulating Valve

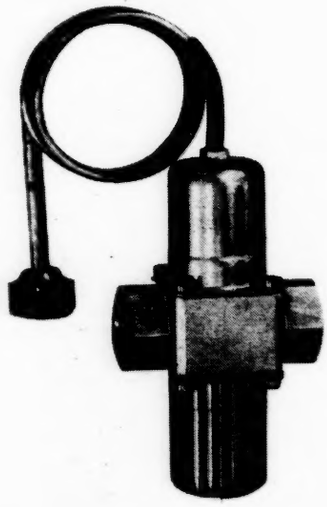
NAME—Model 65 water regulating valve.

PURPOSE—A water regulating valve that is actuated by head or receiver pressure.

FEATURES—Valve is installed in the condenser water inlet or outlet with the head pressure connection placed directly into the high pressure side of the system. Valve may be installed in any position and is said to be self-cleaning. Orifice is wiped clean by the action of the sliding plastic seat. Hydraulic O-ring seals prevent water leakage into the spring and bellows domes. All parts that come in contact with water are made of stainless steel, plastic, or brass. Head or receiver pressure actuates the bellows which in turn moves the valve slide across the valve seat. A rise in condenser pressure opens the valve while a drop in condenser pressure will close the valve.

SIZES AND CAPACITIES—Valve is available in ⅜, ½, and ¾ inch I.P.T. and for an operating range from 65 to 180 lb per sq ft and for use with compressors up to 6 hp.

LITERATURE AVAILABLE — Bulletin M150.



MADE BY—*Automatic Products Co., 2450 N. 32nd St., Milwaukee 10, Wis.*

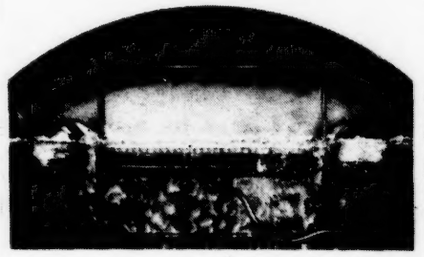
Item 413

Floating Skimmer

NAME—Floating skimmer.

PURPOSE — To achieve automatic blowdown of suspended and dissolved solids from a point at or near the water surface in stationary and locomotive boilers.

FEATURES—Unit is made of stainless steel and consists of a shallow, adjustable trough 20 inches long, five inches wide and two inches deep, suspended between two 6½-inch diameter floats. A screen is mounted over the trough. Drainage from the trough is through a flexible stainless steel hose, normally connected to a fixed outlet pipe in the side of the boiler shell. When installed, the skimmer floats at or near the water surface and is kept in position by guide rods fastened



to the top of the boiler shell. Unit is designed to provide automatic continuous blowdown at a predetermined point near the water surface regardless of fluctuations in the water level. It is adjustable so that the skimming trough may be submerged to the proper distance below the surface depending on boiler operating pressure, steaming conditions, and blowdown requirements. The stainless steel screen mounted over the trough is designed to delay the rapid passage of steam bubbles and to cause a larger percentage to break over the trough.

MADE BY—*Boiler Specialties Corp., 608 S. Dearborn St., Chicago, Ill.*

Item 414

Maid-O'-Mist Air Valve

NAME—72 Auto-Vent.

PURPOSE—To rapidly vent air from hot water heating systems.

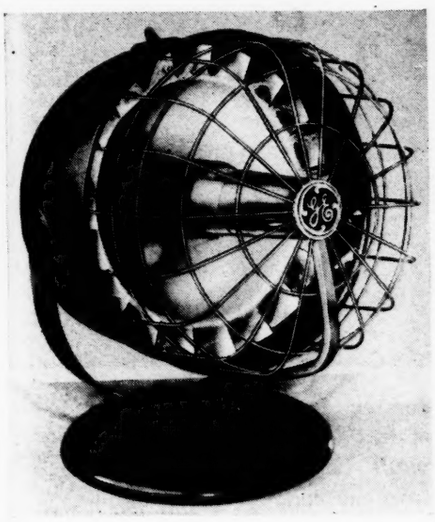
FEATURES—Valve has been designed and sized specially for installation on convectors, baseboard, and free-standing radiators. All expansion and contraction of the special composition disk is confined to four venting slots instead of employing the entire seat of the valve. This, plus an internal siphon tube, is said to result in fast venting. Valve is made of non-ferrous metals.

MADE BY—*Maid-O'-Mist, Inc., 3217 N. Pulaski Rd., Chicago 41, Ill.*

Item 415

G-E Heater

NAME — General Electric portable electric heater.
PURPOSE — Portable space heating unit.
FEATURES — Heater has a highly



polished aluminum fan blade which takes the place of the customary non-reflecting small fan and this blade revolves at a slow speed to produce air movement with the greatest throw of heat. Heating element is a nickel-chromium coil wound around a ceramic core. The fan heater proper is suspended between U-shaped arms that rise from a circular steel base. Heat can be directed at any angle. A concealed handle in the back of the heater remains cool to the touch even when the heat is turned on. Motor is controlled by a fingertip toggle switch.
SIZES AND CAPACITIES — Designed for 120 volts, a-c, heater is rated at 1,320 watts.
MADE BY — *General Electric Co., Bridgeport, Conn.*

Item 416

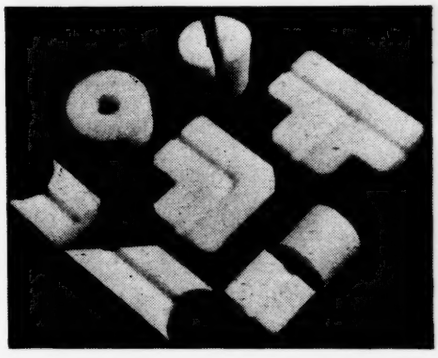
Rusco Window

NAME—Rusco prime window.
PURPOSE—Vertical slide type window with glass or screen inserts that can be removed from the inside of the house.
FEATURES — Window is made of Armco hot-dipped galvanized steel finished with bake-on outdoor aluminum enamel. Tubular construction provides added strength and rigidity with minimum weight. Glass is bedded in mastic and is held in place by a removable stainless steel spline. Window slides freely and automatically locks in any ventilating position. No balances or weights are required. Locking mechanism assures positive locking in either open or closed position. Lumite plastic screen cloth is used in window screen frame. The plastic screen insert remains in place the year round and, besides providing ventilation, acts as a protective barrier against children falling out of the window. Glass and screen inserts are removed easily from inside of the home. Window may be had with inside adjustable self-storing insulating panels to provide benefits of double glass insulation.
SIZES AND CAPACITIES — Available in 20 standard slide units.
LITERATURE AVAILABLE—Bulletin.
MADE BY—*The F. C. Russell Co., 1100 Chester Ave., Cleveland 1, Ohio.*

Item 417

K-Shield Insulation

NAME—K-Shield.
PURPOSE—An expanded plastic type insulation for cold applications.
FEATURES—Insulation is made of expanded Styrofoam. Although the material is airy looking and weighs about 1¼ to 1½ lbs per cubic foot, it is rigid and provides its own moisture barrier. It has a high moisture vapor resistance and the outside of the covering is treated so that the outer layer of air cells are closed. Insulation is being used on pipe lines where temperature ranges from 175F to minus 250F.
SIZES AND CAPACITIES—Available in three-foot lengths, it is fabricated



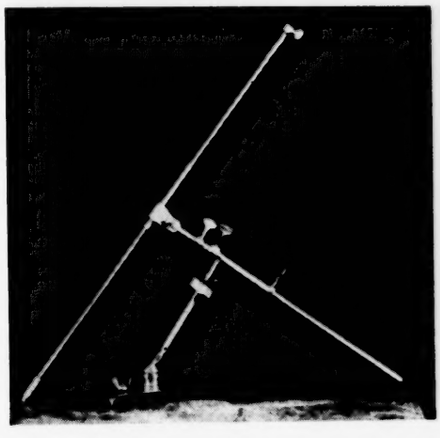
for all standard pipes and fittings. It is also fabricated for special insulating process equipment such as tanks, pumps and accumulators.
MADE BY — *Robinson Industries, 3051 Curtice Road, Coleman, Mich.*

Item 418

SMW Pattern Maker

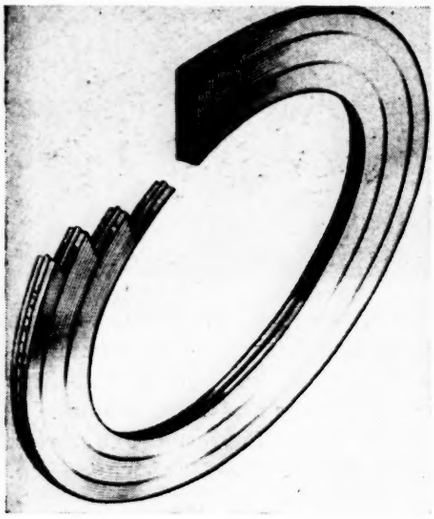
NAME—SMW pattern maker.
PURPOSE—A pattern making instrument for sheet metal workers and fabricators of piping systems, designed to avoid drafting operations.
FEATURES—Instrument is a modified parallel-leg compass with an adjustable radius bar. The scribe leg slides in a bearing on the radius bar to project desired shapes onto any surface. It marks out cutting openings and other joining lines required to fit round, square, or odd shape ducts into round or other shaped objects.
MADE BY—*E. A. Scott, 45 W. 45th St., New York, N. Y.*

Item 419



Flexitallic Gasket

NAME—Flexitallic gasket.
PURPOSE—A flexible metal gasket for high pressure and high temperature applications.
FEATURES—The basic spiral-wound



feature developed by the company is used in this gasket design. Makers claim that the gasket does not take the permanent set customarily expected with solid metal gaskets. Several types of ferrous and nonferrous metals are used in combination in constructing this gasket.
SIZES AND CAPACITIES—In addition to the former standard thicknesses of 0.175 and 0.285 inch size, 0.125 inch is also available.
LITERATURE AVAILABLE—Catalog.
MADE BY—*Flexitallic Gasket Co., Camden, N. J.*

Item 420

McAlear Pilot

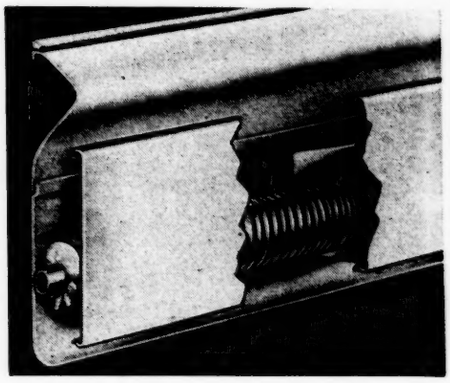
NAME—McAlear pilot No. 1500.
PURPOSE — For increased accuracy in the control of diaphragm motor valves.
FEATURES—The unit requires a constant supply of clean, dry air or gas at a pressure not below 30 lb per sq in. as an operating medium. This air is reduced to a 17 lb limit by the air set. Increased sensitivity of response is said to result by the use of a spiral spring which is furnished in either type 316 or 410 stainless steel or beryllium bronze depending on the service requirements and the pressures. Hysteresis is said to be almost entirely eliminated. A newly developed linkage of stainless steel transmits deflections of the helix. A cast aluminum case encloses all working parts of the control and need be opened only when resetting either the controlled pressure or the throttling band. All piping connections to the unit, as well as between the unit and the diaphragm motor valve, are located to provide easy installation. Two accessible control knobs govern the only two adjustments normally required to operate. Turning the controlled pressure knob repositions the linkage between the spiral sensitive spring and the controlled unit, and automatically indicates the controlled pressure on the scale. The second knob determines the throttling band.
LITERATURE AVAILABLE — Bulletin No. 150.
MADE BY—*McAlear Manufacturing*

Co., 1901 S. Western Ave., Chicago 8, Ill.

Item 421

National Baseboard

NAME—National Art baseboard.
PURPOSE—Baseboard heating.
FEATURES — Heating element consists of ¾-inch commercial copper tube on which is bonded a series of helical copper fins. Steel enclosure is provided in the form of a back panel assembly and a front panel assembly. Heating elements, back and front panel assemblies in 8-ft lengths, are each packaged six pieces to a carton so that the placing of the back panel and heating element along the wall surface is possible without opening front panel cartons until needed to complete the job. Makers claim that the front panel will not become too hot even



for children to touch. When installed semi-recessed along the outer walls it extends only 1½ inches into the room from the wall.
SIZES AND CAPACITIES — With a water temperature of 170F, rating is 370 Btu per hr. Connections are ¾ inch.
MADE BY—*The National Radiator Co., Johnstown, Pa.*

Item 422

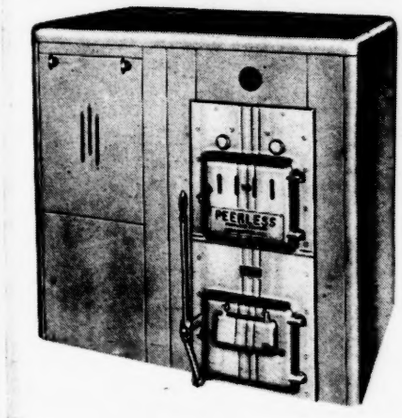
Edward Instrument Valve

NAME — Edward forged steel instrument valve.
PURPOSE—To provide close regulation on small lines and for use with small control equipment.
FEATURES — Constructed of carbon steel, 13% chromium stainless steel, and 18-8 stainless steel, valves are available in globe or angle design with screwed or socket welding ends. They have outside screw and yoke construction and the yoke is screwed onto the body and tack welded. Valves made of stainless steel, since they are corrosive resistant, are suitable for use around chemical processing plants.
SIZES AND CAPACITIES—In sizes of ¼, ⅜ and ½ inch. Carbon steel valves are rated at 1,500 lb at 850F; 13% chromium and 18-8 stainless steel, 1,500 lb at 1,000F.
LITERATURE AVAILABLE—Illustrated bulletin.
MADE BY — *Edward Valves, Inc., East Chicago, Ind.*

Item 423

Peerless Furnace

NAME—Peerless Thermejector steel furnace.
PURPOSE—Space heating.
FEATURES—Coal-fired unit is illus-

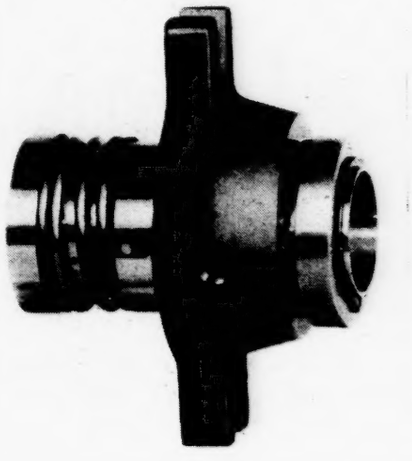


trated, but furnace is also supplied for oil or gas. Peerless blower unit is said to be silent when operating. All joints in combustion boiler and radiator are double sealed, riveted and welded. Duplex roller-bearing rotating grates sift the ashes at outer edges to keep the wall of the fire-pot clean. Rotary type grates ride on four rollers in the grate frame for easy operation. The hot water coil which fits above the feed door does not interfere with shaking or firing. A special direct draft damper is controlled from the front outside of the casing. Vertical baffles within the radiator are said to retard the flow of hot gases, thus forcing the heat to the outside walls of the radiator.
SIZES AND CAPACITIES — In four sizes from 115,500 to 160,000 Btu at the bonnet.
MADE BY — *The Peerless Foundry Co., Inc., Indianapolis 7, Ind.*

Item 424

Peerless Seal

NAME — Peerless mechanical shaft seal.
PURPOSE — To provide a positive shaft seal for installation on equipment moving liquids.
FEATURES — Each seal is so constructed, it is claimed, that regardless of the pressure differential between the liquid and the atmosphere, the force between the sealing faces is only the force developed by the spring installed in the unit. Seal is of the cartridge type and so constructed that replacement and maintenance have been simplified. The seal to be applied depends upon the abrasive qualities of the liquid, the corrosion problems encountered, and the relative lubricating qualities of the liquid being handled. Makers claim that liquids such as water, gasoline, alcohol, hydraulic fluids, ammonia, brine, as well as concentrated or boiling acids and caustics, can be successfully sealed. The seals have cemented tungsten carbide or boron carbide sealing faces for both the stationary ring and the rotating ring. Maximum pressure recommended is 400 lb per square inch for liquids with no water cooling on the stuffing-boxes and temperatures up to 250F; with water cooled stuffing-boxes, temperatures up to 300F.

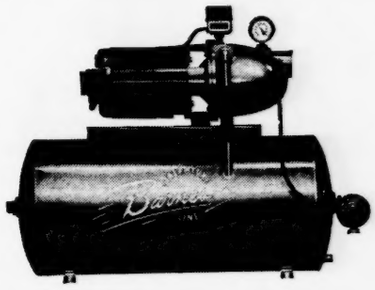


MADE BY—*Peerless Pump Division, Food Machinery & Chemical Corp., Los Angeles, Calif.*

Item 425

Rocket Water System

NAME—Rocket packaged jet water system.
PURPOSE — Packaged water system for use with shallow well installations.
FEATURES — Unit has a one-piece housing with a single-piece, all-bronze nozzle and venturi built into the housing to assure alignment of parts. Smooth inner surfaces and the absence of water detours are said to add to the increased output of the system. Unit is provided with noise dampeners and is rubber mounted. System has direct drive,



U-cup seal, balanced impeller, heavy duty motor, and self-lubrication.
SIZES AND CAPACITIES—Available in 1/3 and 1/2 hp sizes to deliver up to 840 gph.
LITERATURE AVAILABLE—Bulletin.
MADE BY — *Barnes Manufacturing Co., Mansfield, Ohio.*

Item 426

Strong Strainer

NAME—Strong Y strainer.
PURPOSE—Strainer for the protection of steam traps, reducing valves, and temperature controls.
FEATURES—Unit has an extra heavy semi-steel body with self-centering screen guides to prevent crushing. Monel screen is provided and so placed that it is easily removed for cleaning. Gripping lugs on inlet and outlet bosses permit installation with any type of wrench.
SIZES AND CAPACITIES—Sizes from ¼ to 4 inches and for steam pressures up to 600 lb per sq in.
MADE BY—*Strong, Carlisle & Hammond Co., Cleveland, Ohio.*

Item 427

Flame Arrestor

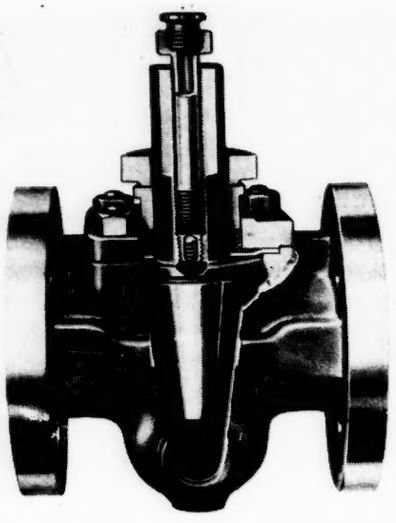
NAME—VVH pressure-vacuum vent valve with flame arrestor.
PURPOSE — To prevent propagation of flame into storage tanks containing volatile liquids.

FEATURES—The flame arrestor bank fits into the throat of the pressure vacuum vent valve and becomes an integral part of the valve body. This arrestor bank, constructed of rolled aluminum, can be removed for cleaning or replacement by releasing the retaining ring spring. Rubber-to-metal sealing is used. The unit consists of a cover, base, arrestor bank, retaining ring, vacuum ring, shock absorber and diaphragm plug.
MADE BY—*Black, Sivalls & Bryson, Inc., 720 Delaware, Kansas City 6, Mo.*

Item 428

Durco Plug Valve

NAME — Durco type D lubricated plug valve.
PURPOSE — For handling corrosive slurries and for any general corrosive service where quick-opening valves are required.
FEATURES — Lower part of plug proper is of Duriron or Durichlor. These are hard corrosion-resisting alloys that are resistant to both corrosion and abrasion. The assembly combines the corrosion resistance of the high silicon iron plug with the physical properties of a stainless steel stem. Valve can be lubricated with lubricant gun or lubricant sticks. The Teflon diaphragm at the bottom of the stuffing-box provides, it is said, an antifriction corrosion-proof seal. Packing gland is made of Durimet 20, a highly alloyed corrosion-resisting stainless steel.
LITERATURE AVAILABLE—Bulletin.

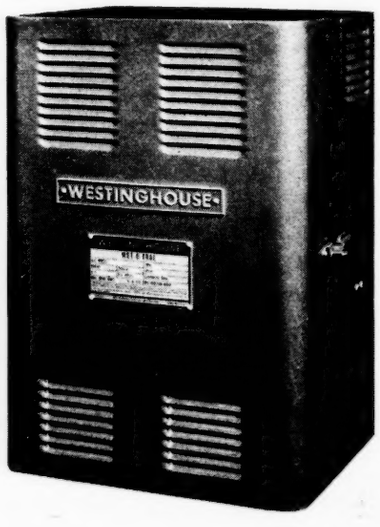


MADE BY—*The Duriron Co., Inc., Dayton 1, Ohio.*

Item 429

Mot-O-Trol

NAME—Mot-O-Trol.
PURPOSE—An electronic adjustable speed drive for fractional horsepower motors of ⅛ to ½ hp d-c operated from single phase 50- to 60-cycle and 220- to 440-volt.
FEATURES—Drive uses armature control to make possible a speed range of 20 to 1 at constant torque. Besides providing smooth stepless speed control on either speed increase or speed decrease, the drive provides dynamic braking, overload and low voltage protection. Separate field rheostats and line-starters are not required. A small compact control station is supplied for separate mounting at a location convenient to the operator.
MADE BY — *Westinghouse Electric Corp., Pittsburgh 30, Pa.*

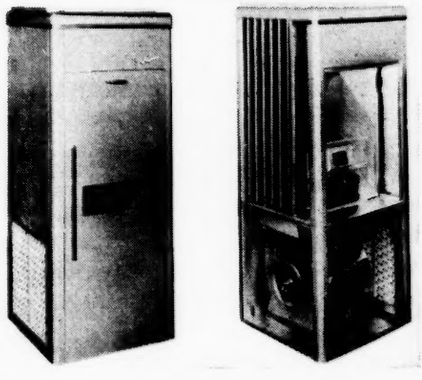


Item 430

Sphinx Furnace

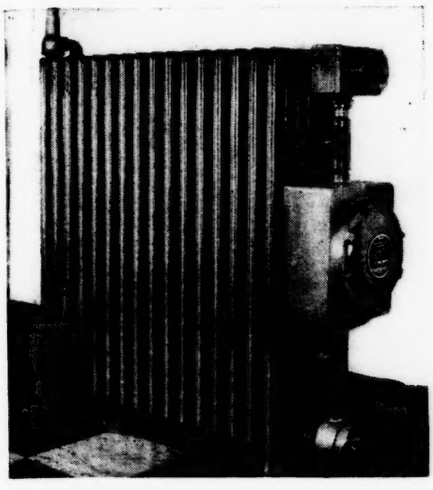
NAME—Sphinx furnace, series 100.
PURPOSE—Space heating.
FEATURES—A corrugated 14-gage steel heat exchanger has over 7,500 sq in. of heating surface. A non-clog all cast burner is used, with separate venturi bells for each burner port, with hollow flame spreaders which pre-heat and direct the secondary air. All working parts are accessible. Two 20 x 20 filters are installed. Dual safety controls are provided and a MH modulating thermostat and valve are installed for maintaining close temperature control. Unit has AGA approval and comes completely wired as a packaged unit. Flange on reversible filter door permits quick installation of cold air return duct. A 10-inch blower is used, operated by a 1/6 hp motor in two models.
SIZES AND CAPACITIES — Available in three models with output ratings at the bonnet of 48,000, 56,000 and 68,000 Btu.
MADE BY—*C. L. Bryant Corp., 4610 St. Clair Ave., Cleveland 3, Ohio.*

Item 431



Warco Radiator

NAME — Warco electrically heated radiator.
PURPOSE—For space heating, particularly for hazardous locations.
FEATURES—An integral thermostat

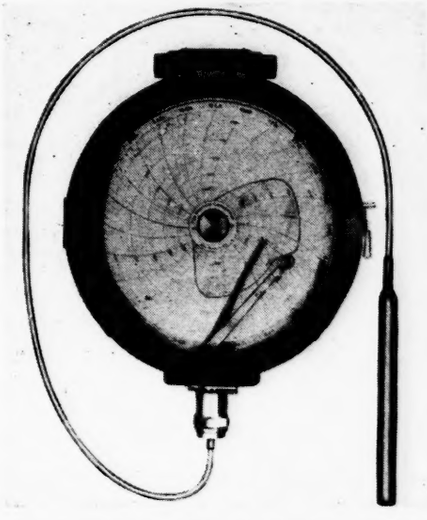


is provided to control the maximum temperature of the radiator. A magnetic contactor, installed as an integral part of the unit, is used to break the heater load. Radiator is cast iron tested at 120 lb per sq in. and is sealed after being filled with a special heat transfer liquid. A Chromalox immersion heating element is used. The system is pressurized to obtain higher operating temperatures. The system is provided with a preset pressure relief valve. Entrance hubs are tapped for ¾-inch conduit.
SIZES AND CAPACITIES — Heating capacity at 6 kw consumption is 20,200 Btu per hr. Heater may be connected for 220-230 single-phase; 220-230 three-phase, or 440-460 single-phase operation.
MADE BY—*L. R. Ward Co., 2711 Commerce St., Dallas, Tex.*

Item 432

Partlow Controller

NAME — Partlow time-temperature controller, models *AT* and *ATC*.
PURPOSE — Time-temperature controller for the enforcement of any desired heating or cooling program.
FEATURES — The time-temperature program is first laid out on a blank cam which is then cut and placed on the controller. A roller arm follower, coupled to the temperature setting mechanism of the controller, follows the contour of the cam that is rotated by a clock mechanism. This changes the temperature setting and causes temperature to be maintained in conformity with a setting program. Cam is removable by loosening a single friction nut so that a change of program cam can be made easily. Model *AT* has a temperature indicating pointer to show whether the actual temperature is below or above the setting as provided by the cam. Model *ATC*, illustrated, has a standard recorder chart and pen. Chart revolves with the cam so that a record is made of the actual time-temperature program. Recorder is intended for a two-wire or three-wire circuit, with a switch capacity of four amperes at 125 volts or two amperes at 250 volts, a-c, non-inductive load, or 50 volt-amperes on inductive loads. Maximum temperature, 1,000F.
MADE BY—*The Partlow Corp., New Hartford, N. Y.*



Item 433

G-E Motor

NAME—General Electric, fractional horsepower motor, type KSP.
PURPOSE—For use as drives for exhaust fans, cooling fans, evaporative coolers, space heaters, etc.
FEATURES—Motor is available either as an open or totally enclosed unit. A new lubrication system provides a constant flow of oil from a large reservoir to the bearing surfaces regardless of the position of the motor. Oil-saturated packing continuously feeds the bearing with filtered oil. No additional lubricant is required. Stator windings are of Formex insulated wire. Vibration-absorbing resilient end rings are said to be resistant to oil and aging. Unit includes resilient end ring mounting, resilient cradle base, and band mounting.
SIZES AND CAPACITIES—From 1/40 to 1/12 hp at 115 or 230 volts, 60 cycles, and speeds of 1050 and 1550 rpm.
MADE BY — *General Electric Co., Schenectady 5, N. Y.*

Item 434

NOVEMBER, 1949

TO OBTAIN FURTHER INFORMATION ON NEW EQUIPMENT

On the list below, circle the item number of the equipment in which you are interested, using the number found at the end of each item.

401	402	403	404	405	406	407	408	409
410	411	412	413	414	415	416	417	418
419	420	421	422	423	424	425	426	427
428	429	430	431	432	433	434		

Print your name and address, detach and mail to
Editor, HEATING AND VENTILATING, 148 Lafayette St., New York 13, N. Y.

Firm (Must be shown) .....

Business Address .....

Name .....
(For prompt service, title and firm name must be shown above.)

Title (Must be shown) .....

City .....**Zone**....**State**.....11/49

Abstracts AND Reviews

Publications abstracted in this department should be ordered direct from publisher.

METHODS OF JOINING PIPE

Before an engineer can design and a contractor install a satisfactory piping system, it is important that they have a thorough understanding of the pipe joints that are available. As no joint is generally suitable for all applications, it is helpful to have information regarding the advantages and disadvantages of each type so that the proper joint may be specified.

Since piping systems are installed to convey liquids, vapors or gases at various temperatures and pressures, and the substance conveyed may be either corrosive, abrasive or inactive, a wide variety of piping material has been developed. Besides the proper basic selection of pipe material the influencing factors in choosing a suitable pipe joint are the service for which the line is designed, temperature and pressure conditions, pipe size and pipe location, labor available for making the joints and for servicing after the line is installed, installation and maintenance costs, and ability to repair the joint without shutting down the system.

The proper selection of pipe joints, based on intelligent consideration of these factors, is effectively and comprehensively covered by J. E. York, engineer, Stone & Webster Engineering Corp., in his new book, Methods of Joining Pipe, which illustrates and describes all types of pipe joints, including expansion joints. It is a valuable reference book for every engineer concerned with piping.

The text is grouped in the following ten chapters: screwed joints for ferrous and brass pipe; flanged pipe joints; welded and brazed pipe joints; methods of joining cast iron pipe; joints for thin wall tubes; joints for plumbing and chemical-resistant pipe; joints for vitreous tile and concrete pipe; joints for transite pipe; joints for wood pipe; and joints to permit movement. Included also are data on gasket material and uses.

Methods of Joining Pipe, by J. E. York. Cloth bound, 5½ x 8½ inches, 236 pages. Published by The Industrial Press, 148 Lafayette St., New York 13, N. Y. Price, $3; Canada and foreign $3.40.

RADIANT HEATING

Results of more than thirty years' experience in radiant heating, radiant cooling and extensive studies in snow melting are presented in the second edition of Radiant Heating, by T. Napier Adlam, vice president, Sarco Manufacturing Co., and consultant on radiant heating. It covers important developments both in the United States and Europe, and is designed to answer the hundreds of questions that are raised whenever the subjects of radiant heating and snow melting are discussed.

The first edition, which was published in 1947, has been expanded to include the newest developments and the latest information. Material has been added to the chapter on ceiling panels to include enclosed convector panels, gravity warm air panels, and forced warm air panels. The chapter on floor panels has been increased to cover research on the physiological aspects of heated floors. Data have been added on floor panels in chicken brooder houses.

The chapter on walls, metal panels, and electrical conductors has been increased to cover important developments in electrical rubber panels, portable electric screens, and radiant glass panels. Added data are provided on embedding electric conductors in the plaster of ceilings and walls to form heating panels.

Because of the great interest in snow melting and the increased number of snow melting installations, the chapter on snow melting has been increased in size to cover practical information for those who plan to design snow melting systems.

In the back part of the book are a set of 78 working charts for the easy direct determination of the pipe sizing necessary, covering both iron or steel pipe and copper tubing. Added to the charts that were part of the first edition are charts on single or double wood floors with rubber tiles, asphalt flooring, carpeting on single wood floors, carpeting and felt pads on wood floors, and painted steel wall panel.

Here is a practical book, devoid of the extensive mathematics that one often finds associated with material on the design of radiant heating systems. The charts and data simplify the step-by-step procedure in the design of such panels.

Both the engineer and contractor, as well as the student, will find the information in this volume easy to understand, and the design procedure easy to follow. It is a book that should be in the library of every heating engineer.

Radiant Heating (second edition), by T. Napier Adlam. Cloth bound, 6 x 9 inches, 504 pages. Published by The Industrial Press, 148 Lafayette St., New York 13, N. Y. Price, $6.

THE MOTION PICTURE THEATER

Recognizing the need for an exchange of technical information on theater planning and design, the major part of the semiannual convention of the Society of Motion Picture Engineers that was held in New York City in 1947 was devoted to technical aspects of the motion picture theater. The papers presented covered the subjects of planning, construction, maintenance, modernization, and theater television.

Because of the interest in the subject, the papers and the discussion of these papers at the conference are now available in book form.

Of particular interest are the four papers in the section on Ventilating and Air Conditioning. These are Motion Picture Theater Air Conditioning, by Dwight D. Kimball; Air Purification by Glycol Vapor,

by J. W. Spisselman; Ultraviolet Air Disinfection in the Theater, by L. J. Buttolph; Service and Maintenance of Air Conditioning Systems, by W. B. Catt. The other sections of the book include auditorium design, acoustics, lighting, floor coverings, promotional display, and theater television. Each of the subjects is covered by men considered specialists.

The Motion Picture Theater, cloth bound, 6 x 9 inches, 428 pages. Published by the Society of Motion Picture Engineers, Inc., 342 Madison Ave., New York 17, N. Y. Price, $5.

BELL & GOSSETT HANDBOOK

An instruction manual covering the design and installation of modern forced hot water space heating systems and service water heating systems is provided in the second edition of this handbook. It is intended to cover all practical design and installation data on forced water space heating systems and service water heating systems, in a manner easily understood, and the information arranged for quick reference.

The manual is divided into six sections as follows: Principles of indirect water heating, principles of forced hot water heating, heat loss determination, electrical controls, B & G products pertaining to hot water systems, and supplementary data.

Covered in the manual are many piping arrangements, descriptions of systems, and step-by-step calculations to determine the heat load. Data are also presented for determining pipe sizes.

Valuable information is given on the design of radiant panel systems with illustrations of typical floor and ceiling panel installations.

Bell & Gossett Handbook. Limp plastic cloth binding, 8½ x 11 inches, 141 pages. Published by Bell & Gossett Co., Morton Grove, Ill. Price, $4.

REFRESHER NOTES

To help prepare engineers who are planning to take examinations for professional engineers' licenses, refresher notes have been prepared to cover the fields of hydraulics, thermodynamics, and machine design. This book is being used as the textbook for the refresher course sponsored by the Metropolitan Section of the American Society of Mechanical Engineers.

Although the first edition of these notes appeared over one year ago, this material has been expanded in the revised edition to include additional practice problems, an appendix embracing a table of engineering constants, a set of saturated ammonia and steam tables, and a Mollier chart for steam.

While it is intended primarily for a preliminary study for the license examination in New York State, it has been found helpful by engineers preparing for examinations for engineers' licenses in other states.

The author has attempted to screen out the non-essential information and to present problems asked at previous examinations, together with solutions.

Refresher Notes, by J. D. Constance. Paper bound, 8½ x 11 inches, 183 pages. Published by J. D. Constance, 625 Hudson Terrace, Cliffside Park, N. J. Price, $4.50.

MINES BUREAU COAL RESEARCH — In information circular 7518R, the Bureau of Mines summarized the research work that it carried on regarding coal and presents an annual report of research and technologic work on coal, fiscal year 1948. Both laboratory research and pilot plant experimentation were carried on in the field of synthesis gas. The Bureau tested more than 6,800 coal samples, and analyzed 6,300 additional samples of coal and coal products in research on the mining, preparation and utilization of coal. A new cleaning and de-watering process was developed for fine size coal. Improved methods were discovered in other fields. Bureau of Mines, Publication Distribution Section, 4800 Forbes St., Pittsburgh 13, Pa.

TURBINES, CONDENSERS, FEEDWATER HEATERS AND EVAPORATORS—A report by the Turbines and Condensers Subcommittee of the Prime Movers Committee, Edison Electric Institute, covers turbines, condensers and auxiliaries, feedwater heaters and evaporators in publication No. R-3. Forty-eight operating companies contributed by sending data to the Committee for use in the publication of this report. The 77-page report is divided into five sections as follows: turbines, turbine operating and outage data for 1946 and 1947, simultaneous unscheduled outages of major plant equipment, condensers and auxiliaries, and feedwater heaters and evaporators. Price, $1.40, Edison Electric Institute, 420 Lexington Ave., New York 17, N. Y.

WARM AIR DESIGN PROCEDURES — Form No. 5 has been issued by the National Warm Air Heating and Air Conditioning Association to present a design procedure for the perimeter warm air heating system for single-story, slab-on-ground houses of not more than 60,000 Btu heat loss. This procedure was developed by the Installation Codes Committee and the Research Advisory Committee of the Association in cooperation with members of the mechanical engineering department of the University of Illinois. The heating system outlined has a split system combining both warm air floor panel radiant heating and convection heating. This system is based on the use of 8-inch round galvanized ducts embedded in the concrete near the outer edges of the slab. The 4-page form is designed for use with the Association's Manual No. 3 entitled Measuring Heat Loss. Price of form, $6.00 per hundred with a minimum quantity order of 50. Manual No. 3, 60 cents each. National Warm Air Heating and Air Conditioning Assn., 145 Public Square, Cleveland 14, Ohio.

NATIONAL BUREAU OF STANDARDS REPORT—A summary of investigations in the physical science carried on at the National Bureau of Standards during the fiscal year of 1948 is described in this 272-page, illustrated booklet. Activities of the Bureau during the year were conducted by 13 divisions. Of the varied projects carried out by about 100 sections within the divisions, those of greatest general interest and widest application were selected for description. Research and housing problems receive emphasis, particularly the problem of applying engineering principles to structural design. Superintendent of Documents, Government Printing Office, Washington 25, D. C. Price, 25 cents.

DEGREE-DAYS FOR SEPTEMBER, 1949

(A) Airport readings; (C) City office readings; (O) Readings at a point on outskirts of city.

HEATING AND VENTILATING'S 22nd Year of Publication of Monthly Degree-Day Data

City	September			Cumulative, September 1 to September 30			Heating Season[1]
	1949	1948	Normal	1948-49	1947-48	Normal	Normal
Abilene, Texas (A)	6	10	0	6	10	0	2061
Albany, New York (A)	208	136	72	208	136	72	6580
Albuquerque, New Mexico (A)	6	80	0	6	80	0	4298
Alpena, Michigan (C)	260	130	222	260	130	222	8299*
Anaconda, Montana (C)	303	316	335	303	316	335	8357**
Asheville, North Carolina (C)	100	47	0	100	47	0	4232
Atlanta, Georgia (C)	23	7	0	23	7	0	2890
Atlantic City, New Jersey (C)	57	40	0	57	40	0	5176
Augusta, Georgia (C)	4	4	0	4	4	0	2161
Baker, Oregon (C)	164	275	258	164	275	258	7163
Baltimore, Maryland (C)	47	25	0	47	25	0	4533
Billings, Montana (A)	203	124	189	203	124	189	7119
Binghamton, New York (C)	200	132	108	200	132	108	6808
Birmingham, Alabama (A)	25	4	0	25	4	0	2352
Bismarck, North Dakota (A)	272	99	222	272	99	222	9192
Block Island, Rhode Island (C)	78	63	0	78	63	0	5788
Boise, Idaho (A)	90	155	102	90	155	102	5552
Boston, Massachusetts (A)	105	76	48	105	76	48	6045
Bozeman, Montana (C)	282	228	336	282	228	336	8521**
Buffalo, New York (A)	206	93	75	206	93	75	6822
Burlington, Iowa (A)	182	56	(a)	182	56	(a)	(a)
Burlington, Vermont (A)	197	163	144	197	163	144	7514
Butte, Montana (C)	326	338	344	326	338	344	8235**
Cairo, Illinois (C)	53	15	0	53	15	0	3909
Canton, New York (C)	237	174	189	237	174	189	8020
Charleston, South Carolina (C)	0	0	0	0	0	0	1769
Charlotte, North Carolina (C)	28	18	0	28	18	0	3120
Chattanooga, Tennessee (A)	36	3	0	36	3	0	3118
Cheyenne, Wyoming (A)	218	143	240	218	143	240	7466
Chicago, Illinois (C)	126	19	76	126	19	76	6077
Cincinnati, Ohio (C)	86	26	0	86	26	0	4684
Cleveland, Ohio (A)	180	75	27	180	75	27	6155
Columbia, Missouri (C)	112	31	0	112	31	0	4922
Columbia, South Carolina (C)	13	7	0	13	7	0	2364
Columbus, Ohio (C)	130	45	0	130	45	0	5398
Concord, New Hampshire (A)	234	184	168	234	184	168	7353
Concordia, Kansas (C)	96	33	0	96	33	0	5315
Dallas, Texas (A)	5	2	0	5	2	0	2256
Davenport, Iowa (C)	152	42	0	152	42	0	6289
Dayton, Ohio (A)	182	55	0	182	55	0	5264
Deer Lodge, Montana (C)	310	386	399	310	386	399	8672**
Denver, Colorado (C)	76	37	72	76	37	72	5874
Des Moines, Iowa (C)	136	36	0	136	36	0	6384
Detroit, Michigan (A)	182	74	42	182	74	42	6490
Devils Lake, North Dakota (C)	301	118	276	301	118	276	9970
Dodge City, Kansas (A)	69	34	0	69	34	0	5035
Dubuque, Iowa (C)	190	57	36	190	57	36	6790
Duluth, Minnesota (C)	315	137	270	315	137	270	9483
Eastport, Maine (C)	238	272	276	238	272	276	8520**
Elkins, West Virginia (A)	220	129	63	220	129	63	5697
El Paso, Texas (A)	0	2	0	0	2	0	2428
Ely, Nevada (A)	183	247	(a)	183	247	(a)	(a)
Erie, Pennsylvania (C)	147	67	36	147	67	36	6273
Escanaba, Michigan (C)	305	123	243	305	123	243	8771
Evansville, Indiana (A)	112	22	0	112	22	0	4244
Fort Smith, Arkansas (A)	35	10	0	35	10	0	3147
Fort Wayne, Indiana (A)	202	67	0	202	67	0	5925
Fort Worth, Texas (A)	6	1	0	6	1	0	2148
Fresno,California (A)	1	18	0	1	18	0	2334
Galveston, Texas (C)	0	0	0	0	0	0	1016
Grand Junction, Colorado (A)	31	18	0	31	18	0	5548
Grand Rapids, Michigan (C)	184	55	57	184	55	57	6535
Green Bay, Wisconsoin (C)	276	124	132	276	124	132	7825
Greensboro, North Carolina (A)	52	28	0	52	28	0	3529
Greenville, South Carolina (A)	41	19	0	41	19	0	3380
Harrisburg, Pennsylvania (A)	116	71	0	116	71	0	5375
Hartford, Connecticut (A)	132	90	48	132	90	48	6036
Hatteras, North Carolina (C)	1	0	0	1	0	0	2571
Havre, Montana (C)	211	177	270	211	177	270	8700
Helena, Montana (A)	301	255	251	301	255	251	7894**
Houston, Texas (C)	0	0	0	0	0	0	1157
Huron, South Dakota (A)	215	79	123	215	79	123	8004
Indianapolis, Indiana (A)	155	52	0	155	52	0	5298
Jackson, Mississippi (A)	10	12	0	10	12	0	(a)
Kansas City, Missouri (A)	79	13	0	79	13	0	4956
Knovxille, Tennessee (A)	50	12	0	50	12	0	3670
La Crosse, Wisconsin (A)	195	98	96	195	98	96	7322
Lander, Wyoming (A)	198	136	276	198	136	276	7947

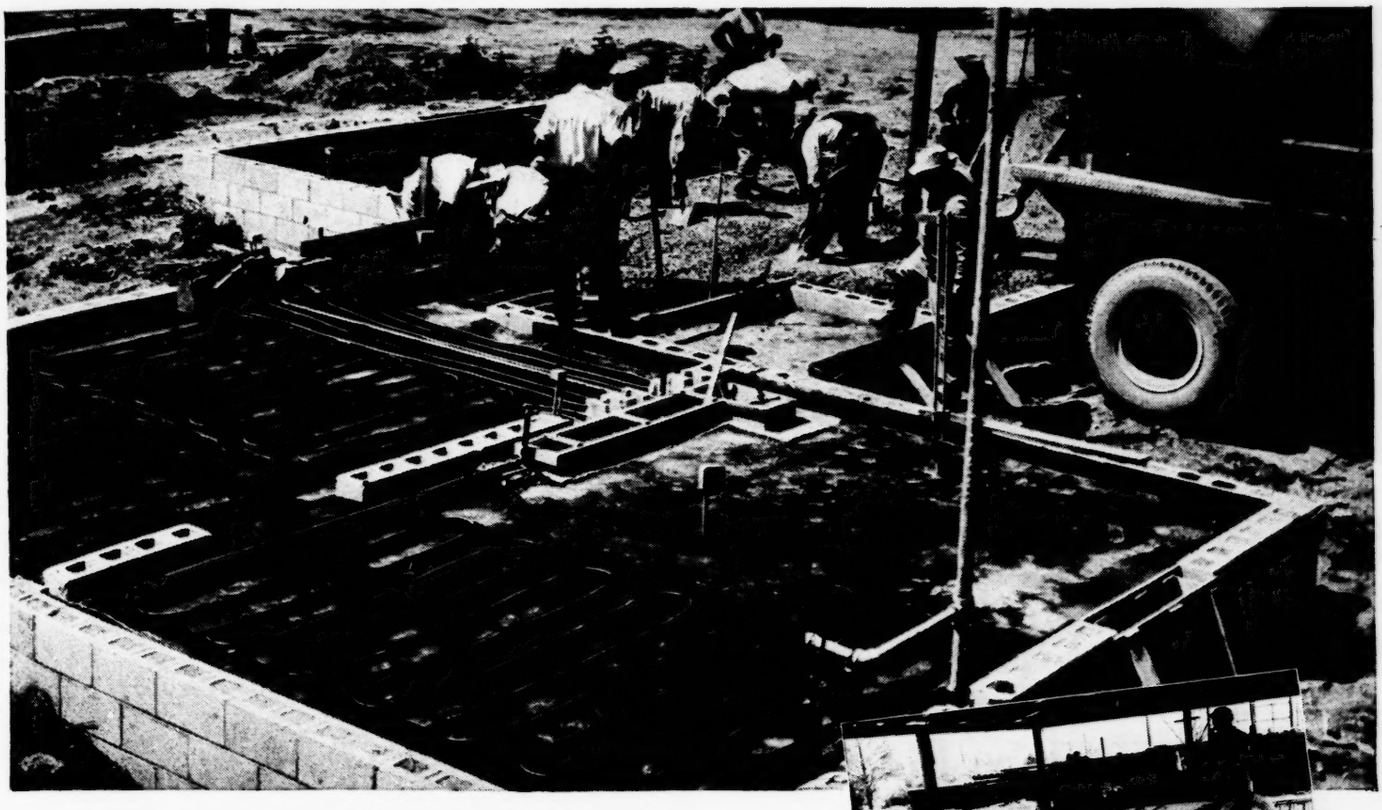
(a) Data not available.

[1]Figures in this column are normal totals for a complete heating season, September to June, incl.

Figures in this table, with seven exceptions, based on local weather bureau reports. Exceptions are Utica and Lewiston, figures for which are furnished through the courtesy of Coke Sales Department, Central New York Power Corp., Utica, N. Y., and Norman E. Ross, Bursar, Bates College, Lewiston, Me., respectively; Anaconda, Bozeman, Butte, Deer Lodge and Livingston, Mont., through the courtesy of the Montana Power Company.

[Table concluded on page 108]

102½ MILES OF REVERE COPPER WATER TUBE AT OAK RIDGE, TENN.



TO SAVE TIME AND MONEY IN HANDLING and installing the radiant panels for heating, the Revere Copper Water Tube was speedily bent into wooden forms by hand, then wired to temporary frames and stacked flat until needed. Tube sizes run from ⅜" to 1¼".

500 Permanent Homes to be heated by RADIANT PANEL METHOD

This huge project of 500 permanent homes being built for the U. S. Atomic Energy Commission at a cost of $6,500,000.00 by John A. Johnson & Sons, Inc., Oak Ridge, Tenn., will consume 540,900 feet of Revere Copper Tube to be used for radiant panel heating, water lines and service connections.

As more and more radiant panel heating systems are being installed, more and more contractors and builders are finding out that they like to work with Revere Copper Tube. They have found they can trust it to guard against leaks, inadequate flow and faulty circulation . . . that it is unusually easy to handle and bend, has full wall thickness and close dimensional tolerances so essential for tight soldered joints. And, installed, Revere Copper Tube costs little or no more in the first place . . . may be much less in the long run.

NEW REVERE BOOKLET MAKES IT EASY TO DESIGN FOR RADIANT PANEL HEATING

This booklet, "A Simplified Design Procedure For Residential Panel Heating," contains the most simple, rapid method of design for panel heating ever devised. Send for your *free* copy today!

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, New York

• • •

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Degree-Days for September, 1949 (Concluded)

(A) Airport readings; (C) City office readings; (O) Readings at a point on outskirts of city.

HEATING AND VENTILATING's 22nd Year of Publication of Monthly Degree-Day Data

City	September			Cumulative, September 1 to September 30			Heating Season[1]
	1949	1948	Normal	1948-49	1947-48	Normal	Normal
Lansing, Michigan (A)	247	98	114	247	98	114	7048
Lewiston, Maine (O)	201	120	165	201	120	165	7707
Lincoln, Nebraska (C)	122	42	0	122	42	0	5999
Little Rock, Arkansas (A)	27	10	0	27	10	0	2811
Livingston, Montana (C)	235	175	227	237	175	227	7245**
Los Angeles, California (C)	0	4	0	0	4	0	1504
Louisville, Kentucky (A)	93	24	0	93	24	0	4180
Lynchburg, Virginia (A)	85	52	0	85	52	0	3980
Macon, Georgia (C)	9	3	0	9	3	0	2201
Madison, Wisconsin (C)	220	69	87	220	69	87	7429
Marquette, Michigan (C)	299	161	225	299	161	225	8693*
Memphis, Tennessee (A)	29	16	0	29	16	0	2950
Meridian, Mississippi (C)	12	11	0	12	11	0	2160
Milwaukee, Wisconsin (A)	203	73	84	203	73	84	7245
Minneapolis, Minnesota (A)	208	58	93	208	58	93	7850
Montgomery, Alabama (C)	5	3	0	5	3	0	1884
Nantucket, Massachusetts (A)	102	112	63	102	112	63	5957
Nashville, Tennessee (A)	43	20	0	43	20	0	3507
New Haven, Connecticut (A)	108	71	39	108	71	39	5895
New Orleans, Louisiana (C)	0	89	0	0	89	0	1024
New York, New York (C)	53	20	50	53	20	50	5274***
Nome, Alaska (A)	Degree-Days for June, 1949 (not previously published) are 765. Total for season (Sept. 1, 1948 to June 30, 1949) is 14,369.						
Norfolk, Virginia (C)	12	1	0	12	1	0	3350
North Head, Washington (C)	201	222	255	201	222	255	5452**
North Platte, Nebraska (C)	156	60	42	156	60	42	6366
Oakland, California (A)	38	107	90	38	107	90	3143**
Oklahoma City, Oklahoma (C)	38	6	0	38	6	0	3613
Omaha, Nebraska (A)	137	36	0	137	36	0	6131
Oswego, New York (C)	172	118	114	172	118	114	7088
Parkersburg, W. Virginia (C)	127	50	0	127	50	0	4775
Peoria, Illinois (A)	168	39	3	168	39	3	6109
Philadelphia, Pennsylvania (C)	46	21	36	46	21	36	4737***
Phoenix, Arizona (C)	0	0	0	0	0	0	1405
Pittsburgh, Pennsylvania (C)	120	60	0	120	60	0	5235
Pocatello, Idaho (A)	130	165	156	130	165	156	6655
Portland, Maine (A)	239	160	162	239	160	162	7218
Portland, Oregon (C)	59	121	105	59	121	105	4469
Providence, Rhode Island (C)	100	68	63	100	68	63	6015
Pueblo, Colorado (A)	43	41	6	43	41	6	5514
Raleigh, North Carolina (C)	26	14	0	26	14	0	3234
Rapid City, South Dakota (A)	184	76	144	184	76	144	7118
Reading, Pennsylvania (C)	93	50	0	93	50	0	5389
Red Bluff, California (A)	2	19	(a)	2	19	(a)	(a)
Reno, Nevada (A)	139	163	144	139	163	144	5892
Richmond, Virginia (C)	36	28	0	36	28	0	3695
Rochester, New York (A)	209	114	72	209	114	72	6732
Roseburg, Oregon (C)	51	135	111	51	135	111	4428
Roswell, New Mexico (A)	7	30	0	7	30	0	3484
Sacramento, California (C)	3	28	0	3	28	0	2653
St. Joseph, Missouri (A)	106	24	0	106	24	0	5161
St. Louis, Missouri (C)	70	16	0	70	16	0	4585
Salt Lake City, Utah (A)	58	86	18	58	86	18	5555
San Antonio, Texas (A)	0	0	0	0	0	0	1202
San Diego, California (A)	1	6	0	1	6	0	1645
Sandusky, Ohio (C)	120	44	0	120	44	0	6208
San Francisco, California (C)	106	154	114	106	154	114	3264**
Sault Ste. Marie, Michigan (A)	355	193	276	355	193	276	9285**
Savannah, Georgia (A)	1	0	0	1	0	0	1490
Scranton, Pennsylvania (C)	166	99	60	166	99	60	6129
Seattle, Washington (C)	112	180	186	112	180	186	4934**
Sheridan, Wyoming (A)	233	133	264	233	133	264	8008
Shreveport, Louisiana (A)	9	0	0	9	0	0	1938
Sioux City, Iowa (A)	180	49	33	180	49	33	6898
Spokane, Washington (A)	155	236	192	155	236	192	6355
Springfield, Illinois (C)	96	27	0	96	27	0	5373
Springfield, Missouri (A)	106	42	0	106	42	0	4428
Syracuse, New York (A)	180	135	96	180	135	96	6893
Tacoma, Washington (C)	156	230	207	156	230	207	5181**
Terre Haute, Indiana (A)	138	42	0	138	42	0	4872
Toledo, Ohio (A)	203	75	9	203	75	9	6077
Topeka, Kansas (C)	79	20	0	79	20	0	4969
Trenton, New Jersey (C)	84	46	0	84	46	0	4933
Utica, New York (O)	146	91	182	146	91	182	6796
Valentine, Nebraska (C)	190	74	93	190	74	93	7039
Walla Walla, Washington (C)	64	131	30	64	131	30	4808
Washington, D. C. (C)	55	27	0	55	27	0	4626
Wichita, Kansas (A)	59	19	0	59	19	0	4673
Williston, North Dakota (C)	277	121	270	277	121	270	9323
Winnemucca, Nevada (C)	126	153	192	126	153	192	6427**
Yakima, Washington (A)	127	191	120	127	191	120	5599

(a) Data not available.
*Includes August.
**Includes July and August.
***New 48-year normal covering 1898 to 1946.
[1]Figures in this column are normal totals for a complete heating season, September to June, incl.

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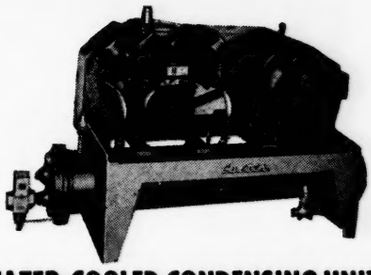

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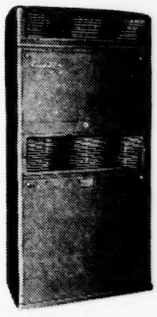

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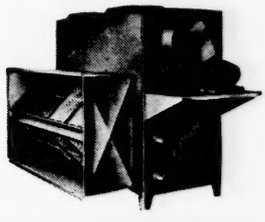

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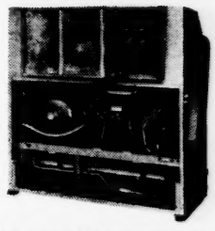

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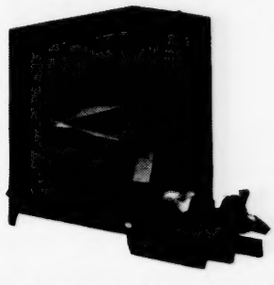

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NEWS OF THE MONTH

SEPTEMBER BUILDING CONTRACTS

show substantial gains to run up highest single month since wartime peak.

F. W. Dodge Corporation reported spectacular increases in the dollar-volume of building and construction contracts awarded in September in the 37 states east of the Rocky Mountains to bring the total to $1,093,724,000, the highest reported for a single month since June 1942 when wartime construction was at its peak.

It was the second time in the Dodge statistical series dating back to pre-boom years in the Twenties that more than a billion dollars in awards were reported for a single month in the 37 eastern states.

The month's record volume cancelled deficits of earlier months to bring the cumulative dollar volume for the first three quarters of the year to 1% higher than in the corresponding nine months of 1948.

• **PRIVATE.**—Investments by private owners accounted mainly for the advances, the over-all contract total for projects classified as privately owned amounting to $804,970,000 to show a 37% jump over August and 60% increase over September of last year. Public-account awards last month amounted to $288,754,000 or 9% less than in August and 11% more than in September last year.

Residential awards in the 37 states last month totaled $525,572,000 to reflect a 34% gain over August and 88% over September of last year. Private residential building accounted for 96% of last month's volume. Substantial gains were reported for both apartment houses and single-family dwellings.

• **NONRESIDENTIAL.** — Nonresidential awards last month totaled $345,023,000. This volume was 24% higher than in August and 23% greater than in September a year ago. Private nonresidential volume last month showed gains of 40 and 26% respectively over August and over September of last year, while public volume was off 5% from August and up 17% over September of last year. Extraordinary gains were reported last month for commercial, educational, science, and religious buildings.

Heavy engineering awards failed to follow the upward trend shown in residential and nonresidential building, last month's total of $223,129,000 being off 5% from August but up 10% over September of last year.

• **THIRD QUARTER.**—At the end of the third quarter of the year the cumulative total of awards was $7,410,708,000 in the 37 states against $7,345,773,000 in the corresponding nine months of last year, a gain this year of 1%. Public-account awards were up 17% and private work was down 7% in the period. Nonresidential awards were running 5% less, residential awards 3% more, and heavy engineering awards 6% more than in the corresponding three quarters of last year.

SLUM CLEARANCE

and urban redevelopment programs to be powered by Federal funds.

Two major new housing programs, the slum clearance and urban redevelopment program and the broad housing research program authorized by the Housing Act of 1949, received their go-ahead signal with completion of Congressional action on the Supplemental Appropriation Act for fiscal year 1950 containing funds for the administration of these and other provisions of the Act.

Raymond M. Foley, Administrator of the Housing and Home Finance Agency, said that the Agency is ready to move immediately on completion of administrative organization and development of plans and procedures for setting both these programs in motion at the earliest practicable moment.

• **TO EXPAND STAFF.**—The appropriation will also enable the Public Housing Administration to expand its staff to be ready to follow up on reservations of public housing units that it has already been making on a two-year basis on applications filed by local housing authorities. The Department of Agriculture likewise received administrative funds and authorization for loans and grants to carry out the farm housing section of the Housing Act of 1949.

Nathaniel S. Keith, recently appointed director of the Division of Slum Clearance and Urban Redevelopment under the HHFA Administrator, estimated that the Housing and Home Finance Agency will be in position to issue application forms, operating instructions, and regulations around the first of the year to cities applying for slum clearance aid.

• **GETTING STARTED.** — Mr. Keith said that a few cities seem sufficiently well along in their local organization and plans so that the first slum clearance and redevelopment contracts can be entered into during the first six months of next year and the actual clearance of slum areas can be started shortly thereafter.

"The slum clearance program involves more than allocating funds—it involves carefully considered plans and procedures both by the cities and the Federal Government," Mr. Keith said. "We expect to proceed as rapidly as is consistent with sound planning, but to take the time necessary to insure against costly initial mistakes through thorough preparation and adequate consideration of proposals at the outset."

• **FUNDS.**—Title I of the Housing Act of 1949 authorizes $1 billion in Federal loans and $500 million in Federal grants to cities, to become available over a period of five years for the purpose of acquiring, clearing, and preparing slum and blighted areas for redevelopment. Mr. Keith explained that launching such a program entails a series of steps that require time.

"At the Federal level," he said, "we must first hire a competent staff of specialists in various fields, such as planning, finance, real estate appraisal, and law. We

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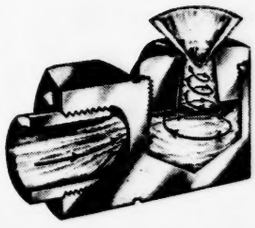

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must develop the necessary procedures and forms based on a thorough study of the new Federal law and the various state laws for the use and guidance of the cities that wish to apply.

• **PROCEDURE.**—"When initial proposals are submitted, they must be reviewed for their conformity to Federal requirements, including the legal authority of the local agency set up to do the job, the conformity of the proposed redevelopment plan with a general city plan, the eligibility of the project for Federal assistance under the Act, and other matters. The Federal Government may then make an advance of funds to enable the city to draw up a detailed proposal, including cost estimates, and provision for rehousing displaced families, for the actual acquisition and clearance of the area. When these detailed proposals are reviewed and approved, a contract will be entered into that will enable the city to undertake actual clearance."

Much of the preliminary work, such as study of the Act and review of state legislation is already well under way by personnel assigned from the Office of the Administrator. Information on requirements to be met have been sent to some 500 cities and towns throughout the country, and specific consultation and advisory aid has been extended to some 50 cities that have definite plans for proceeding with slum clearance programs.

• **ELIGIBLE.**—On the basis of the Agency's information to date, 20 cities have well developed basic plans for slum clearance projects and may be able to proceed with drafting detailed submissions without the necessity of an advance loan. About 50 cities seem sufficiently well along in local organization and general planning to be able to apply for advance loans within the next few months. About 100 other cities have indicated definite intentions of participating in the slum clearance program and are organizing for that purpose.

• **EFFECT.** — The effect of the appropriation on the new housing research program will be to enable the Agency to recruit the necessary staff of technical, statistical and economic specialists to develop and carry out a long-range program of coordinated housing research with other agencies and with private industry in order to find methods of providing better housing for more people at lower cost. The immediate result, Mr. Foley said, will be to accelerate some of the work already under way under past limited authorizations, chiefly in the field of improved building codes and the advancement of standardized dimensions in building materials, and to initiate arrangements through existing facilities and with the staff to be recruited for launching additional and broader studies that have been drawn up in blueprint stage.

• The flame characteristics of natural gas are so different from those of manufactured fuel gases that a change in gas supply from manufactured to natural gas necessitates the alteration of all gas-burning appliances, according to a reminder from the National Bureau of Standards reporting on tests of Bunsen and similar types of laboratory burners.

SMOKE PREVENTION CLINIC

established by Anthracite Institute to offer consulting service to users of all types of fuel.

A smoke prevention clinic to aid New Yorkers and particularly owners of large buildings, in preventing smoke in the city has been established at Anthracite Institute, 101 Park Ave., Frank W. Earnest, Jr., president, announced October 24, in conjunction with National Smoke Abatement Week.

The opening of the clinic was attended by the director of the New York City Smoke Control Bureau, William H. Byrne, who praised its objectives.

• **SERVICE.**—The smoke prevention clinic is staffed by ten qualified engineers experienced in smoke prevention and especially in advising building management

Paul F. White, AI consulting engineer, demonstrates CO_2 indicator to be used in flue gas analysis.

and municipal authorities. The clinic's engineers, equipment, and informational material, including lists of commercial consulting engineers and equipment manufacturers, are available without cost to New York building owners and managers.

E. E. Finn, director of the new smoke prevention clinic said it would provide information for three methods of solving smoke problems — "one, with present equipment, fuel, and personnel; two, with admixtures of solid fuels; or three, with changes in fuel, equipment, or personnel." Steps for smoke prevention which will involve no investment or little investment by the individual will be featured by the clinic.

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- TIME-PROVEN DESIGN
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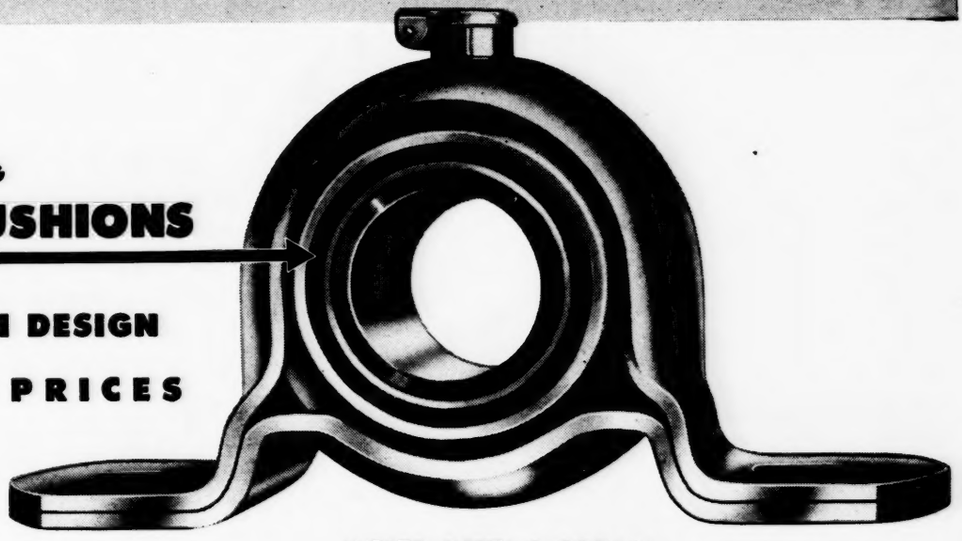
Special mountings designed to meet individual conditions



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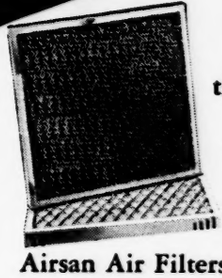

Airsan expanded metal face plate acts as a lint arrestor to provide easier cleaning and servicing and distributes air evenly over entire filtering area, providing high filtering efficiency and dust holding capacity with low resistance. Other features include all galvanized construction and full bronze welded corners.

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ASME PROGRAM

announced for 70th annual meeting in New York week of Nov. 28; engineering in peaceful world is keynote.

More than 270 speakers drawn from university, laboratory and every phase of industry are scheduled to deliver some 200 papers at the 70th annual meeting of The American Society of Mechanical Engineers in New York, November 28 to December 2. It is expected that the meeting will attract upwards of 6,000 engineers from all parts of the country. Headquarters will be the Statler Hotel.

The American Rocket Society, an affiliate of the ASME, will hold its annual dinner on Thursday, Dec. 1, with Undersecretary of the Navy Dan A. Kimball as the speaker.

Dr. Lillian M. Gilbreth, outstanding woman engineer, will address the President's Luncheon on the opening day. Dr. Gilbreth is noted for time and motion studies which she began with her husband, the late Major Frank B. Gilbreth. She adapted principles of industrial management to the home in raising her family of 12 children, two of whom, Ernestine Gilbreth Carey and Frank B. Gilbreth, are the authors of the best seller, "Cheaper by the Dozen."

A brief outline of the meeting by topic follows:

- Applied Mechanics.—Six sessions; ten papers on critical loading of columns of varying cross section; bending of an elliptical plate by edge loading; comparison of flow and deformation theories of plasticity, and others.
- Aviation. — Symposium on air-cargo handling; also a luncheon followed by inspection trip to Newark Airport—possibly flights over New York.
- Boiler-Water Research.—Four papers; hideout of sodium phosphate in high-pressure boilers; sulphite and silicate experience at Springdale Station; treatment of make-up in high-pressure by-product steam plants; and automatic degasser for steam sampling.
- Fuels.—Seven papers on effect of pressure on combustion of pulverized coal; new underground mining procedures; oil-shale processing; practical applications of the anthratube; symposium of fly-ash utilization; report on Illinois smokeless furnace; and gasification of pulverized coal in vortex reactor.
- Gas-Turbine Power.—Survey of AK closed-cycle gas turbines during 1945-1950; 4,000-hp gas-turbine locomotive for passenger service; ceramics in gas turbines; metallurgy of gas-turbine materials, and others.
- Hydraulics.—Three papers on water diversion in the Nantahala Power System; cavitation tests by the vibratory method; water hammer in oil lines; and Hydraulic Oldtimers' dinner.
- Industrial Instruments and Regulators.—Two sessions; four papers on graphical gear-train design; studies in proportional control; automatic temperature control for electrically heated windshields; and automatic machine for analyzing telemetered-missile data.
- Machine Design.—Three sessions; eight papers on such subjects as anti-friction bearings, identifications standards, housings and spindles, maintenance, characteristics of greases, oil lubrication, and others.
- Management.—Six sessions; symposia on obligation of management to be competent, to create a better industrial life, control costs, create quality and improve distribution.
- Marine Power.—Two papers, vibration of marine-turbine blading, and 28,000-ton tanker design.
- Power.—Four sessions; ten papers on economics of reheat; costs of reheat versus non-reheat for 100-mw units, steam-turbine blading development, testing of long steam-turbine blading; storing and reclaiming coal with earth-moving equipment; evaluation of steam-power-plant losses by means of entropy-balance diagram; and others.
- Safety. — Three papers on theory of machine guarding; isotopes as tools of engineering; and handling hot atoms.
- Wood Industries.—Two sessions; eight papers on finishing materials for wood products; spray process for wood finishing; finishing of piano cases and fine furniture; holding power of nails; developments in wood cutters; and pumps and hose for forest-fire fighting.

INDIVIDUAL CONTROL

of office temperatures will be outstanding feature of heating and air conditioning of UN headquarters.

Nearly every worker in the new United Nations Secretariat Building, to be completed in New York next year, will be able to select his own weather conditions.

- **LARGEST.**—In what is believed will be the largest job of individual room temperature control ever installed in an office structure, 4,000 high velocity unit air conditioners in the peripheral area will be used in combination with conventional central conditioning systems for the center areas of the rectangular shaped, 39-story Secretariat.
- **VARIETY.**—J. A. Cutler, president of Johnson Service Co., points out that the prospect of people from 58 nations, representing every known climate extreme and all those in between, working together in one building multiplies many times the familiar problem of maintaining office conditions to everyone's thermal satisfaction. Fortunately, office temperature will never be a barrier to United Nations harmony, for each office in the architecturally unique Secretariat will have its own individual room temperature control. An Icelander, a Saudi Arabian and an Argentinian will be able to work in adjoining offices the year around, while each enjoys the temperature conditions to which he is accustomed at home.
- **SYSTEM.**—Primary air is supplied by a high pressure conduit system and is introduced into the unit, where it mixes with recirculated air which is drawn from the room and through the unit's coil. A heating-

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TYPE TR HORIZONTAL
Low and High Pressure Systems
Ball-bearing — heavy duty
Capacities to 100,000 sq. ft. E.D.R.
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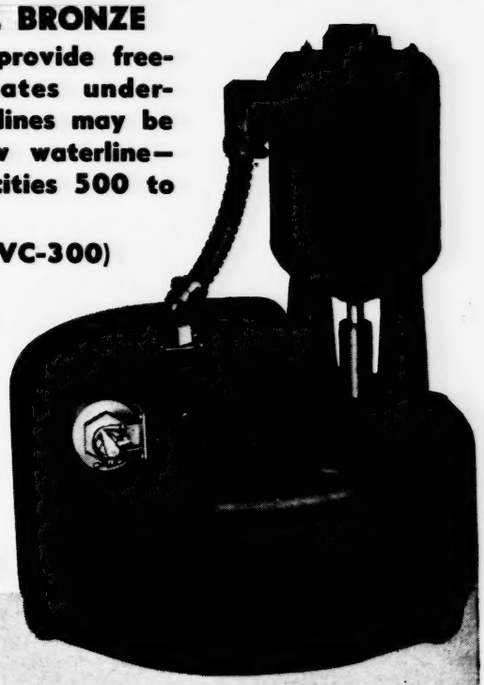
Fig. 302



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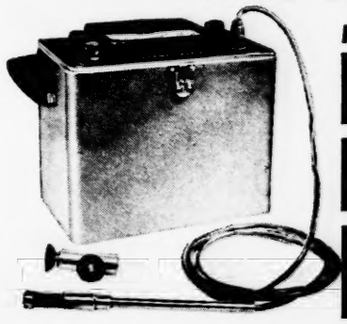

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cooling thermostat, mounted in the unit, will control a valve on the water supply to the coil in the unit. The operation of the valve determines the amount of heat added or extracted from the recirculated air, cold water being supplied to the unit in warm weather and hot water in cold weather. The heating-cooling thermostat can be adjusted to the desired temperature through a small door in the top of the unit. The bulb of the thermostat will be behind the return air grille, where it can accurately sample room air.

Areas in the center of the building will be conditioned by conventional, low velocity central systems with a separate duct to each area. Individual room control will also be provided in these areas.

• **PANEL HEAT.**—The narrow end areas of the Secretariat will be heated by radiant panels, with Johnson weather-compensated controls used to prevent thermal lag in the panels when the weather changes.

It is expected that some 4,000 people eventually will occupy the Secretariat building. The Secretariat is the administrative agency of the United Nations and is responsible for carrying out the programs and policies of the other United Nations branches. The Secretariat building is the first and largest of four which will ultimately comprise United Nations headquarters.

HEAT FROM COWS

boosted with heat pump to warm Swedish homes.

In a paper prepared for the American Society of Agricultural Engineers, Nils Holmquist, chief engineer of the Swedish Government Research Institute for Farm Buildings, tells how a barn with 10 to 15 cows can be used to heat an average 5-room house by means of a suitably arranged heat pump.

An average milking cow, Mr. Holmquist points out, produces about 3,300 Btu per hr. Out of this heat about 25% is latent, in respiratory moisture.

Swedish research has indicated a need of between 40 to 80% of the sensible heat for ventilation. The rest of it, that is, about 40% as an average, disappears in transmission losses.

• **WASTE HEAT.** — About 60% of the sensible heat, plus all of the latent heat, is in fact wasted, as it is ventilated away without having been used in the barn.

Most new or rebuilt barns are so well insulated that the remaining heat will be sufficient for keeping the temperature in the barn high enough for most weather conditions.

In some recent Swedish tests, Mr. Holmquist says, we have tried to make use of this wasted heat for heating the house. It is not possible to introduce the barn air directly to the house, as the temperature in the barn is too low to make it possible to keep the temperature in the house as high as desired. The only way to accomplish it is to raise the heat to a higher temperature through a heat pump.

In our project we have principally placed the evaporator in the duct for the outgoing air from the barn. By passing the air over the evaporator, we are able to remove as much of the latent and sensible heat from it as we want to and as may be economically desirable. All of that heat is pumped to the condenser, which is placed in the house. The best and cheapest way of using the heat is to use a heating system with air that takes its heat from the compressor and condenser and is forced to the different parts of the house by the means of a fan. The heat from the fan motor is also used in heating the air.

In our tests we have given the warm air the possibility of recirculating in the barn. As the air is dehumidified to a certain extent, this system gives very good results and enables us to use the excess heat more efficiently.

When the compressor is not working, being turned off by a thermostat in the house, the barn ventilation is taken care of by means of a regular flue (natural draft or fan ventilation) with a thermostatic control to keep the temperature at 59F.

The location of our test house is such that the lowest design temperature at which the heating system should be calculated is 5F. Those extreme low temperatures are, however, very rare and calculations show that it is economically most correct to dimension the heat pump for an outside temperature of 28.4F and to add the extra heat needed for the cold periods by means of direct electrical heating.

As the temperature of the Freon refrigerant is only about 39.2F, when it is pumped from the barn to the house, the pipes could be uninsulated without serious heat losses. The distance from the barn to the house may be as long as 100 meters.

With this system a barn with only 10 to 15 milking cows is sufficient for heating a normal five-room house, without extra insulation either in the barn or the house.

Economically this system should be compared with other means of central heating. In Sweden the most common fuels are oil and coal. With a depreciation in 10 years to 25 years (for different parts of the aggregate), a cost of 2c per kw-hr for electricity and a cost of $45 per ton of heating oil, it is shown that the arrangement with the heat pump will cost $190 per year, compared to $245 for the oil furnace.

The installation was tried in Sweden last winter and preliminary calculations from the tests show that the system is practically and economically realizable.

• Transcontinental Gas Pipe Line Corp. has applied to the Federal Power Commission for authorization to expand the capacity of its Texas-New York City natural gas pipe line, now under construction, from the presently authorized 340 million cu ft per day to a new total of 505 million cu ft. The company purposes to increase deliveries to its presently authorized utility customers and to extend service to two others.

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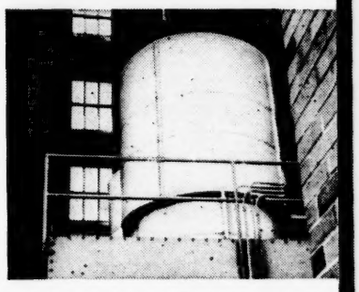

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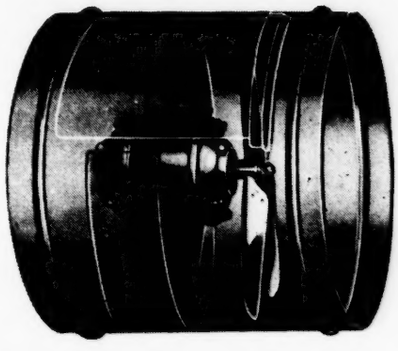

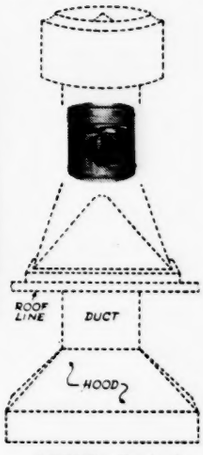

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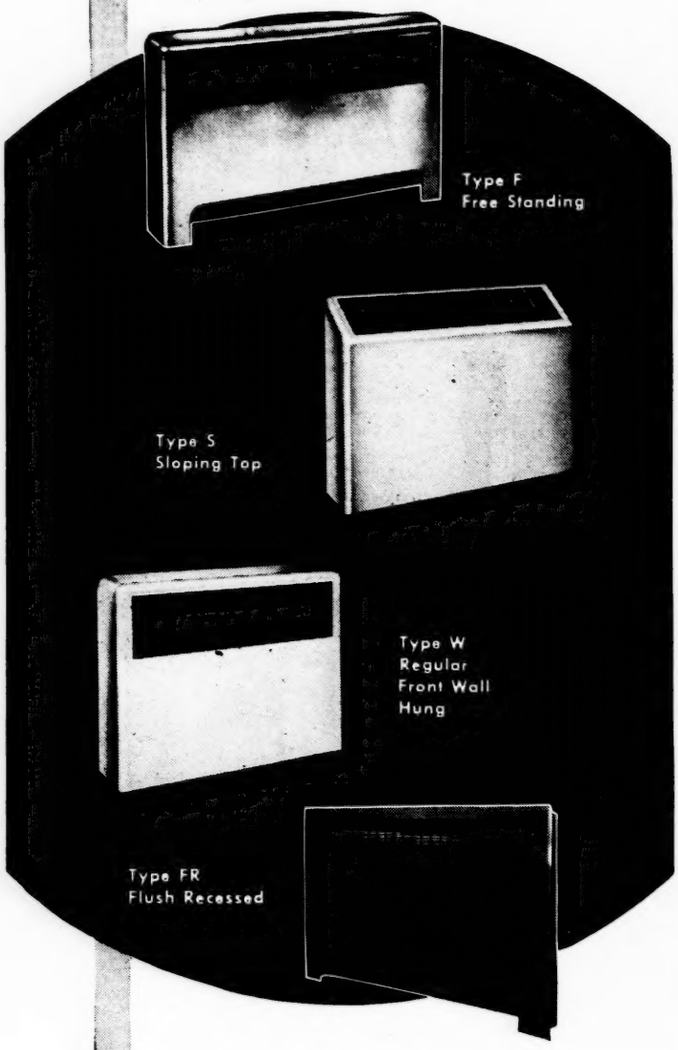

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OXYGEN PIPING SYSTEM

banned for medical center by N. Y. Fire Dept.

An unusual oxygen system installed at Columbia Presbyterian Medical Center at a cost of $35,000 was disapproved by the New York Fire Department.

The Medical Center installation, for which a three-mile network of pipes was laid underground and between floors and ceilings, represented a year's work. It is designed to pump oxygen directly to 600 hospital beds. Of the 600 wall outlets 330 are installed already in Babies Hospital, Presbyterian Hospital and Harkness Pavilion. The remainder were scheduled for completion within the next few months.

• **OTHERS.**—Authorities at Medical Center had hailed the new system as the most extensive therapeutic oxygen piping system in New York, pointing out that only two other Manhattan hospitals, St. Luke's and St. Vincent's, have facilities for piped oxygen.

However, at both these hospitals the oxygen goes to a limited number of rooms only. It is fed there by a manifold bank of standard cylinders from a point inside the building. At Medical Center the oxygen was to be supplied from large trailers outside the hospital.

• **EXPANDED.**—John S. Parke, executive vice president of Presbyterian Hospital, explained that the new system was so geared that eventually it could be extended to its whole main group of hospitals. He not only envisaged the day when outlets would be provided at the center for all its 1,400 beds but when such systems would be installed in hospitals of 200 beds or more. He termed the new system an economy move in patient-day cost that would at the same time provide better care.

John M. Davidson, engineering supervisor who directed the installation of the new system, predicted it would increase the hospital's oxygen consumption by 25%. Each trailer in the parking lot, he noted, holds 40,000 cubic feet under a pressure of 2,400 pounds. Gas at high pressure is reduced at the control station so that no high-pressure gas goes into the building. The gas is humidified by the time it reaches the patient, and no further processing is needed, he said.

Mr. Davidson said the center took no chances on running out of oxygen even with one reserve trailer standing by. A signal board has been installed in the watchman's booth in the hospital basement. When the pressure drops to 600 pounds in the trailer, an alarm bell sounds. As a double precaution, a second signal system functions in the engineer's office.

• **REJECTED.**—The Fire Department rejected the application, made through the architectural firm of Voorhees, Walker, Foley & Smith, to put the system into operation on the ground that "insufficient safeguards have been proposed." Third Deputy Fire Commissioner Nathan C. Horwitz made this assertion following a meeting of its Board of Hazardous Trades under the chairmanship of First Deputy Fire Commissioner James J. Moran.

Mr. Horwitz said notification from the Fire Department went out to St. Luke's Hospital to discontinue its oxygen system. Medical Center was to be informed within the next few days. He said that he was "not convinced" as to the safety of the center's system.

NEW CATALOGS

Central Air Conditioning Equipment

Bulletin 3158-B covers Buffalo Forge central air conditioning equipment, including coils, fans, eliminators, spray nozzles, etc. Several pages are devoted to design and selection of engineering and psychrometric data.—*Buffalo Forge Company, Buffalo 5, N. Y.*

Item 243

Corrosion Service Piping

Bulletin 485, 32 pages, 3 colors, gives data on stainless steel and nickel alloys anti-corrosion piping. Standards, technical data, design tips, and complete dimensional information on stainless fittings and flanges are included.—*Taylor Forge & Pipe Works, Inc., P.O. Box 485, Chicago 90, Ill.*

Item 244

Pipe Cleaning

Industry Report No. 543 shows techniques for cleaning new and used pipe for pipe line construction prior to coating.—*American Wheelabrator & Equipment Corp., 555 S. Byrkit St., Mishawaka, Ind.*

Item 245

Oil Fired Furnace

A 4-page booklet describes and illustrates the new Thatcher 492 Series oil-fired winter air conditioner. Photographs, cutaway views and specifications are included.—*Thatcher Furnace Company, Garwood, N. J.*

Item 246

Hot Water Regulators

Bulletin No. 329 covers the Powers No. 11 self-operated regulator for water heaters, hot water line controls, dryers, etc. Selection and sizing tables are included.—*The Powers Regulator Company, 2718A Greenview Ave., Chicago 14, Ill.*

Item 247

Steam Humidifiers

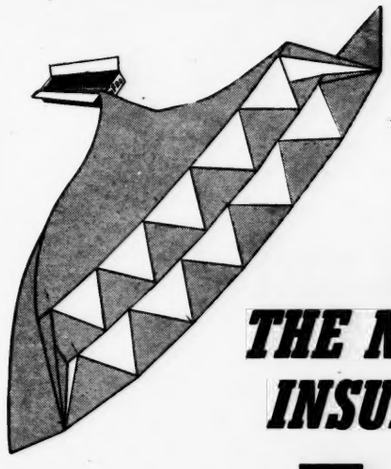
Bulletin No. 1772 covers the Armstrong line of steam humidifiers, including two new air controlled models. Tables cover desirable relative humidities and regain of hygroscopic materials.—*Armstrong Machine Works, Three Rivers, Mich.*

Item 248

Condensate Drainage Control

A new 24-page publication, No. 3250, on the Cochrane C-B system of condensate drainage control comprises six pages of technical discussion of this system of high pressure, high temperature condensate return, followed by specifications of the two types of C-B unit, case histories, flow diagrams, and details of installation. — *Cochrane Corp., 17th St. & Allegheny Ave., Philadelphia 32, Pa.*

Item 249



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Baseboard Heating

Construction details, ratings and the conventional applications of National Art baseboard radiation are covered in catalog No. 559, 4 pages, 2 colors.—*The National Radiator Co., Johnstown, Pa.*

Item 250

Power Shears

A new line of power shears for light gage metal is described and illustrated in Bulletin 71-5.—*Niagara Machine & Tool Works, 637 Northland Avenue, Buffalo 11, N. Y.*

Item 251

Corrosion Resistant Plug Valve

The Durco high silicon iron lubricated plug valve is described and illustrated in Bulletin 640.—*The Duriron Company, Inc., Dayton 1, Ohio.*

Item 252

American-Standard Price Book

Price Book SE-4, dated September 26, 1949, shows trade prices of American Standard Sunbeam gravity furnaces and winter air conditioners.—*American Radiator & Standard Sanitary Corp., Pittsburgh 30, Pa.*

Item 253

Relays

Seven standard types of magnetic relays for industrial and general purpose control applications are described in catalog D-20A, 12 pages, 2 colors. Technical data on ratings, dimensions and specifications are included.—*Ward Leonard Electric Co., 31 South St., Mount Vernon, N. Y.*

Item 254

Temperature Transmitter

The Taylor transaire temperature transmitter for remote recording and indicating of temperatures is described and illustrated in Bulletin 98140 which includes a price list and tables of range limits.—*Taylor Instrument Companies, Rochester 1, N. Y.*

Item 255

Instruments and Controls

A variety of primary and secondary flow instruments and control valves, for all industries, is described in a 24-page illustrated catalog. — *Fischer & Porter Co., Hatboro, Pa.*

Item 256

Radiant Heating Handbook

Simplified design and installation practices for panel heating installations using copper tube are outlined in a 20-page booklet with design principles, installation diagrams, testing methods, and fabricating techniques. —*Copper & Brass Research Association, 420 Lexington Avenue, New York 17, N. Y.*

Item 257

Defrost Units

A looseleaf punched data sheet describes Recoy low temperature automatic defrost units, with sizing, capacity and cost data.—*Refrigeration Economics Co., Inc., Canton, Ohio.*

Item 258

Fastening Specialties

A 28-page manual, looseleaf bound, gives descriptions and engineering data on Southco blind rivets, anchor nuts, panel fasteners, retaining springs, etc.—*South Chester Corp., Finance Bldg., Philadelphia 2, Pa.*

Item 259

Heating Products Wall Chart

A 2-color wall chart, 22x32 inches, illustrates the Dunham line of heating products, including pumps, radiation, unit heaters and heating specialties.—*C. A. Dunham Co., 400 West Madison St., Chicago 6, Ill.*

Item 260

Boilers

Springfield boilers for both straight and bent tube models are described in Bulletin 6A-1, including installation diagrams, auxiliary equipment, and rating tables.—*Springfield Boiler Co., 1965 E. Capitol Ave., Springfield, Ill.*

Item 261

Air Filters for Paint Spray

Applications of permanent washable air filters for paint spray installations are described in an 8-page booklet, Form 1105.—*Department LD, Research Products Corp., 1015 E. Washington Ave., Madison 10, Wis.*

Item 262

Thermometers

A Dillon thermometer bulletin describes and illustrates dial thermometers and stainless steel thermometers for industrial applications in a variety of models.—*W. C. Dillon & Co., Inc., 5410 W. Harrison St., Chicago 44, Ill.*

Item 263

Corrosion Resistant Materials and Equipment

Protective coatings for fans, piping and other equipment, Tygon corrosion resistant plastic tubing, lining materials, grinding equipment, porcelain and stoneware piping, and masonry are described in bulletin M, 8 pages, 2 colors.—*The U. S. Stoneware Co., Akron 9, Ohio.*

Item 264

Corrosion Resistant Equipment

General Catalog M, 12 pages, covers corrosion resistant fans, heaters, heat exchangers, steam jets, pipe and fittings and other products for applications in chemical industries or wherever corrosion of fluid handling equipment is a problem.—*The Duriron Company, Inc., Dayton 1, Ohio.*

Item 265

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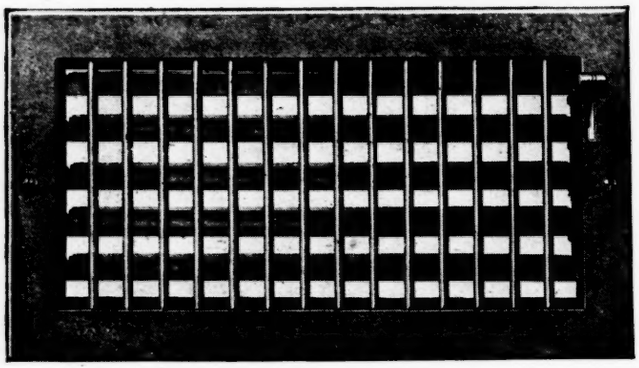
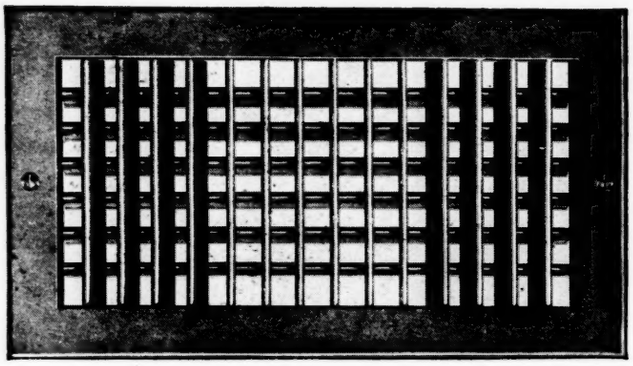


1005V-HML. Single bank of bars, multi-louvre valve.



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Design of bars and method of mounting them are **original** with Auer. Bars are hollow moulded, beveled, perfectly formed, smooth in contour, and pivoted in the frame on special split sleeves. This expansion insert furnishes correct tension to hold bars firmly where set, yet allows sufficient free movement for adjustment with one simple tool. Bars may be set at any angle, in any grouping. Blades of multi-louvre valve are pivoted on rivets to prevent vibration. Streamliner registers are equipped with gaskets. You will be pleased with the beauty and fine craftsmanship of these registers. Write for folder S-49.

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Tile Panel Heating System

A new 32-page booklet issued by the Clay Products Association describes a method of radiant heating, known as RadianTile panel heating. Forced warm air flowing through special hollow floor tiles form a radiant heating panel. The booklet gives several sample installations, design computations, specifications, floor plans, and constructional details. The four tile units from which a RadianTile installation is built are described and their uses shown.—*Clay Products Association, 100 No. LaSalle Street, Chicago 2, Ill.*

Item 266

Cooling Tower Maintenance

A 16-page booklet contains hints on operating and maintaining water cooling towers and gives procedure for putting tower into service, inspection, lubrication, checking and shut-down.—*C. H. Wheeler Mfg. Co., 19th & Lehigh, Philadelphia 32, Pa.*

Item 267

Sheet Cutting Machines

A 6-page folder describes the American Pullmax line of sheet, steel and plate working machines, including attachments for straight, circle and slot cutting, beading and folding.—*American Pullmax Co., Inc., 2627 North Western Ave., Chicago 47, Ill.*

Item 268

Bending Machines

Bending machines for handling pipe and tube, reinforcement bars, and structural shapes are described and illustrated in a 40-page catalog No. 49.—*Wallace Supplies Mfg. Co., 1304 Diversey Parkway, Chicago 14, Ill.*

Item 269

Combustion Controls

Technical bulletin No. 103, 8 pages, 2 colors, describes combustion control by use of the haze index and describes devices for combustion control for all hydro-carbon fuels, including bituminous coal.—*General Power Plant Corp., 381 Fourth Ave., New York 16, N. Y.*

Item 270

NOVEMBER, 1949

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Getting Personal

E. Raymond

Eleanor Raymond (co-author, *Storing Solar Heat in Chemicals—a Report on the Dover House*, page 79), a practicing architect of Boston, Mass., designed the very much publicized solar heated house at Dover, Mass. She received her B.A. from Wellesley College, studied architecture and landscape architecture at the Cambridge School of Architecture, and later attended the graduate school of Smith College from which she received an M. Arch.

In 1927 she opened an architectural office in partnership with Henry A. Frost, head of the Cambridge School of Architecture. Since 1935 she has been the owner of Office of Eleanor Raymond, Architect. During World War II, she was the head of the drafting room at the Radar School of Massachusetts Institute of Technology.

Miss Raymond is registered in Massachusetts, and is a member of the American Institute of Architects. She has specialized in residential work and has built houses in New England and several southern states.

Dr. Maria Telkes (co-author, *Storing Solar Heat in Chemicals—a Report on the Dover House*, page 79) is responsible for the design of the chemical storage system for storing solar heat used in this novel house. Her biography was published in HEATING AND VENTILATING, May, 1947, and a reference section by Dr. Telkes on A Review of Solar House Heating appeared in the September, 1949 issue.

J. R. Jones

J. R. Jones (co-author *Heat Gain from Lighting*, page 65) is a lighting application engineer with the Westinghouse Lamp Division in Bloomfield, N. J. He was born in Pomeroy, Washington, and received his college training at Washington State College. Following graduation from college, he entered the Navy and was commissioned an Ensign after four months' training at the U. S. Naval Academy. He later served as gunnery officer on the U. S. Submarine Tautog which sunk and damaged a larger number of enemy ships than any other ship in the Navy. At the close of the war, he was employed by the Pacific Power and Light Company as a lighting specialist in Dayton, Washington, for a year before joining the commercial engineering department of the Westinghouse Lamp Division.

John D. Constance

John D. Constance (*Effect of Specific Gravity on Ventilation Technique*, page 87), at present chemical engineer in the technical service section of Air Reduction, is a registered professional engineer of New York. After graduation from New York University he spent five years in the heat exchanger and refrigeration industries and two years with Combustion Engineering Co. He then joined the engineering staff of E. B. Badger and Sons Company in their New York petroleum division where he assisted in the engineering design of the Russian oil refineries that company was handling. He has been instructing an evening class of graduate engineers

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• WASHING
• RINSING
• COOLING
• AIR CONDITIONING

YARWAY

SPRAY NOZZLES

FAN-TYPE FOR FLAT SLICING SPRAY

Get the most out of your Spraying Equipment with minimum power . . . with efficient spraying.

Use Yarway Nozzles. No internal vanes or other restrictions to clog or hinder flow. Two types—Yarway Involute-type producing a fine hollow spray with minimum energy loss, and Yarway Fan-type producing a flat fan-shaped spray with time-saving slicing action for cleaning.

Wide range of standard sizes and capacities. Cast or machined from solid bar stock.

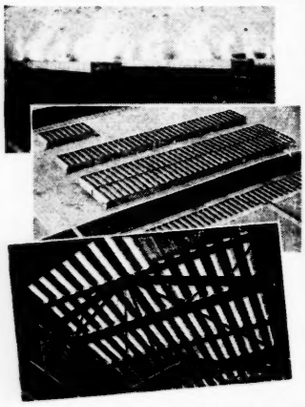
Thousands in use. - - Write for Bulletin N-616.

YARNALL-WARING COMPANY
104 Mermaid Avenue Philadelphia 18, Pa.

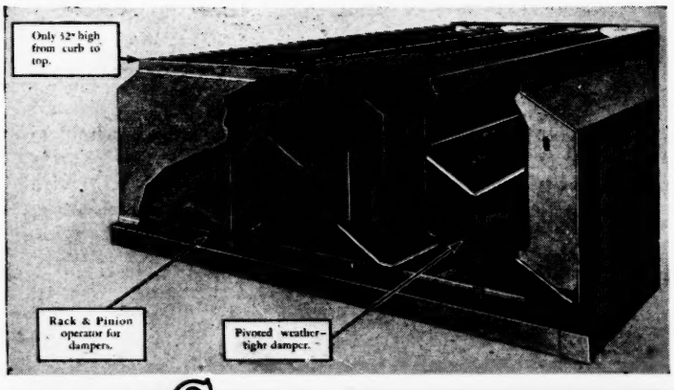
You can provide "Open Roof" ventilation efficiency with Swartwout AIRMOVER

*** without expensive construction**
*** without high installation cost**
*** without power expense**

Still the most revolutionary idea in roof ventilators, AIRMOVER has proved, in six years, to be an invaluable aid to the ventilation of many types of buildings. Only 32" high, its multiple heat valve design offers least possible air travel friction to contaminated air. . . . Construction problems often encountered in applying roof ventilators are simplified. Weight is distributed over a wider roof area. By the same token, air flow has less difficulty in "finding" the roof opening. Used generously over large heat-producing areas, AIRMOVER truly "opens your roofs to the sky." Write for full information.



THE SWARTWOUT CO.
18571 Euclid Ave., Cleveland 12, Ohio



Swartwout Controlled Air Circulation

in the practical application of the basic engineering sciences at the Engineering Societies Building in New York in preparation for the New York State Professional Engineers license examination. He has written a notebook on the subject, which is receiving wide acceptance in many states. He is a member of the National Society of Professional Engineers, the American Institute of Chemical Engineers, and the American Society of Mechanical Engineers.

. . . Since the Last Issue

J. F. Warren

Julian F. Warren, advertising and sales promotion manager of **Delco Appliance Division, General Motors,** has been named to the position of sales manager, Delco-Heat Products.

After attending William and Mary College, Mr. Warren became a retail salesman for Delco-Heat Products. Several years later he became southeastern sales representative for the Pierce Butler Radiator Corp., Syracuse, New York, manufacturers of boilers and radiation. In 1941 he was appointed by Delco Appliance as zone sales manager for southeastern United States and advanced to the position of advertising and sales promotion manager in 1944.

The appointment of **Stuart J. Rice, Jr.,** as manager of advertising and sales promotion was also announced by Delco Appliance Division. Mr. Rice is a native of Corning, New York, and a graduate of Colgate University in the class of 1941. He served for 4 years during the war as a pilot in the United States Navy. Prior to coming to Delco Appliance he was associated with the McGraw-Hill Publishing Co., the Hutzler Advertising Agency, Inc., and the Crosman Arms Co.

Appointment of new branch managers to head the Fiberglas sales offices in New York, Chicago and Detroit has been announced by **Owens-Corning Fiberglas Corp.** Named branch manager in New York was **Harold D. Bates,** formerly general merchandising manager of Philip Carey Mfg. Co. **Russell R. Galloway** was appointed manager of the Chicago branch office. Mr. Galloway was formerly president of Smith Asbestos Co., and earlier was vice president of Certain-teed Products Corp. **John J. Hartnett** was named manager of the Detroit branch office. Mr. Hartnett was formerly general sales manager of the Certain-teed Products Corp., and prior thereto he was a district and division manager of United States Gypsum Co.

The **American District Steam Co.,** North Tonawanda, N. Y., announces the opening of a direct factory sales office at 341 Madison Avenue, New York City. Resident manager is **Lawrence D. Toolan** who was formerly eastern merchandising supervisor of the Sturtevant Division of Westinghouse Electric Corp.

The **Powermatic Ventilator Co.** of Cleveland, Ohio, makers of Iron Lung roof ventilators, intake units, and related items, has announced a change of name to **Iron Lung Ventilator Co.** Headquarters remain at 4019 Prospect Ave., Cleveland 3, Ohio.

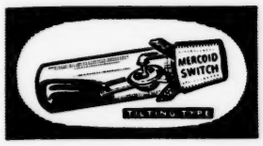
D. C. Goff has been named director of the "Z"-Crete division of the **Zonolite Co.** of Chicago. Mr. Goff, who invented the "Z"-Crete system for insulating underground heating conduits, succeeds L. R. Reeder.

York Corp. has announced the transfer of **Laurence P. Quinlivan** from the Cincinnati branch of the corporation, where he served as industrial sales engineer, to the factory in York, where he will take over the functions of manager, air conditioning sales.

MERCOID

AUTOMATIC CONTROLS FOR HEATING, AIR CONDITIONING, REFRIGERATION AND VARIOUS INDUSTRIAL APPLICATIONS

THE ONLY 100% MERCURY SWITCH EQUIPPED CONTROLS



The distinguishing feature of Mercoid Controls is the exclusive use of Mercoid hermetically sealed mercury switches. These switches are not subject to dust, dirt or corrosion, thereby assuring better performance and longer control life. The items shown below are but a few miscellaneous items. See Catalog No. 700 for the complete line.

Pressure Controls

Temperature Controls

Float Operated Controls

Transformer-Relays

Low Voltage Thermostats

Line Voltage Thermostats

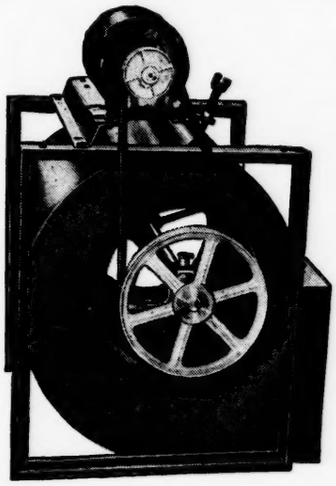
Liquid Level Control

Oil Burner Safety and Ignition Controls

If you have a problem involving the automatic control of pressure, temperature, liquid level, mechanical operations, etc., it will pay you to consult Mercoid's engineering staff — always at your service.

Manufacturers of Dependable Automatic Controls for Over A Quarter of A Century

THE MERCOID CORPORATION · 4223 BELMONT AVE. CHICAGO 41 · ILL.



THE

NEW

UNIVERSAL

TYPE "N"

BLOWER

MASSACHUSETTS . .

By changing the position of the oil cup, the four popular discharges (lower horizontal, upper horizontal, down-blast and up-blast) can be obtained. Sizes 7 to 16½ inches wheel diameter.

WRITE FOR BULLETIN No. 110 CATALOG

MASSACHUSETTS BLOWER DIVISION

The BISHOP & BABCOCK Mfg. Co.

4901 HAMILTON AVENUE · CLEVELAND 14, OHIO

SIMPLE A-B-C's FOR REINSULATION OF UNDERGROUND PIPING

A—Remove roof slab. Clean out old insulation and metal supports. Repair box.

B—Apply parting medium to pipes and fill box with Z-Crete insulating concrete.

C—Reinsulation is completed and is ready for backfilling.

"Z-crete"* Insulation

is a special mix of lightweight cellular concrete, formulated exclusively for use on underground heated piping. It is a permanent type of insulation which does not rot or disintegrate if wetted and so is ideal for reinsulation of box conduits. It is efficient because it is applied thicker and the solid nature of the fill eliminates the possibility of convected air losses. It is dielectric and provides an excellent corrosion protection for the embedded pipes.

Licensed applicators in all principal cities.

**Z-Crete is a registered trademark of Zonolite Company*

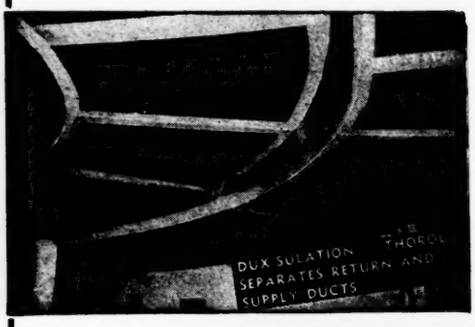
Write or Call Dept. HV- 119

"Z-crete DIVISION

ZONOLITE COMPANY

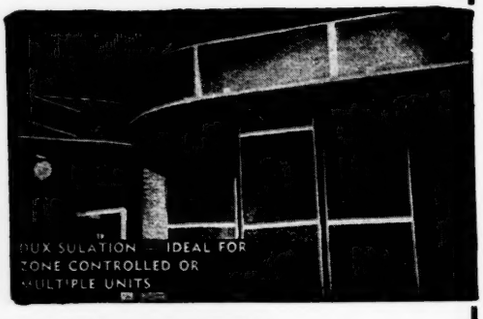
138 S. La Salle St. · Central 6-3865 · Chicago 3, Ill.

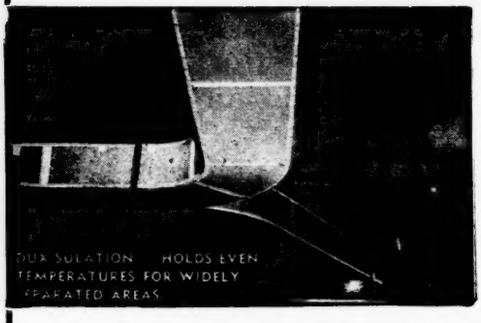
THERE IS ONLY ONE *BEST* DUCT INSULATION IT'S—DUX-SULATION!



Greater security and insulation efficiency — Reduces frictional-resistance and air-turbulences— Gives a clean, modern appearance.

Space and metal are saved. Closely located ducts retain their respective temperatures uninfluenced by varying temperatures of each other.





Permits running duct shorted direction through heated or cooled areas without undue temperature change.

Asbestos-Protected DUX-SULATION has a K factor of .27 B.T.U.—its millions of fine flexible Fibres, interwoven into a heavy Asbestos Membrane, give you many dead air spaces so necessary for high thermal insulation and sound absorption. Saves 75% of heat loss—absorbs 70% of unwarranted noises in less than 10 lineal feet of a lined duct. *Asbestos-Protected* DUX-SULATION deadens noise, prevents condensation, saves fuel and comes in rolls containing 100 square feet, 36" wide, ½" or 1" thick, complete with accessories. It's flexible and easy to apply—no lugs, screws or bolts are needed.

Write for an illustrated Bulletin Series 411-HV and get the facts about this unique flexible Best Duct Insulation!

GRANT WILSON, INC.

BOARD OF TRADE BUILDING
JACKSON BOULEVARD AT LA SALLE STREET
CHICAGO 4, ILLINOIS

A one-story factory building containing 102,000 sq ft has been bought by the **Minneapolis-Honeywell Regulator Co.** to accommodate stepped-up activity of the company's special products division.

Edward G. F. Arnott has been named acting research director of the **Westinghouse Lamp Division,** Bloomfield, N. J. Mr. Arnott, a specialist in the study of gas discharges for fluorescent lamps and electronic tubes, succeeds Dr. Charles M. Slack, whose appointment as technical director of the Westinghouse Atomic Power Division in Pittsburgh was recently announced.

D. W. Norris

D. W. Norris, Pasadena, Calif., president of **The Lennox Furnace Co.,** died suddenly in Columbus, Ohio, on Oct. 5. He was buried in Forest Lawn Memorial Park in Glendale, Calif., on Oct. 10. Mr. Norris was 73 years old. Born in Chicago, Ill., in 1876 Mr. Norris moved with his parents to Grinnell, Iowa, where he was graduated from Grinnell College in 1896. He developed an interest in newspaper work while in college and in 1899 purchased the Marshalltown *Times Republican* of which he was the editor continuously for 50 years, although in recent years his editorial work was confined largely to occasional contributions from his home in Pasadena, or from his offices in some of his Lennox factory cities. Mr. Norris purchased a controlling interest in The Lennox Furnace Co. at Marshalltown, Iowa, in 1904 when its annual output was less than 600 furnaces. Under his direction the company has become the largest manufacturer of warm air heating systems in the world. Mr. Norris was also the principal owner of The Armstrong Furnace Co. and of the Lima Register Co., at Lima, Ohio.

Harold R. Ryan has been transferred back to the Youngstown district as superintendent of the Brier Hill Open Hearth Department of **The Youngstown Sheet and Tube Co.** He succeeds Paul Johnson who recently left the company.

George O. Toepfer, president, The Maag Company, Milwaukee, Wis., was elected president of the **Plumbing and Heating Industries Bureau** at the thirtieth annual meeting October 4 in Chicago. Mr. Toepfer is past president of the National Association of Master Plumbers and currently treasurer of the N.A M.P. Other officers are: **Jack Cooper,** president, Harry Cooper Supply Co., Springfield, Mo., vice president; **Earl E. Brown,** secretary, The Chicago Faucet Co., treasurer; **Norman J. Radder,** Chicago, secretary.

With the appointment of 10 additional manufacturers' representatives, sales of the Multi-Vent division of the **Pyle-National Co.** are now on a national basis. The 10 new representatives are: J. P. Ashcraft Co., 2826 Fondren Drive, Dallas, Texas; R. M. Brand Co., Tucson, Arizona; Joseph P. Maguire, 615 Commercial Place, New Orleans, La.; E. H. Norton, 616 Lloyd Building, Seattle, Washington; Pacific Scientific Co., 1430 Grande Vista Avenue, Los Angeles, Calif.; J. Arch Colbrunn, 1605 McLemore Avenue, Memphis, Tenn.; Francis J. Fallquist, 507 Kuhn Building, Spokane, Wash.; Thomas E. Price, 11 Oak Court, Houston, Texas; Northwest Furnace Supply Co., 911 Northwest Hoyt Street, Portland, Oregon; and S. C. Pardee, Sharon Building, San Francisco, California.

John Howatt, 68, chief engineer of the Chicago board of education for the last 36 years, died October 22 in Illinois Central hospital after an illness of several months. As chief engineer of schools in the nation's second city, Mr. Howatt directed all maintenance of school buildings. Mr. Howatt was educated at the University of Minnesota, from which he was graduated with the degree of mechanical engineer. He was a member and former president of ASHVE.

LEE DIRECT WARM AIR HEATING

Higher Efficiency! Greater Economy!

Direct warm air heating is fundamentally the most efficient means of transferring heat from fuel to air, and is especially suited to the heating of industrial buildings of all types, hangars, etc. Lee Engineering Company was one of the pioneers in this field, and today offers a complete line of both central system heaters and unit heaters. The Lee system gives heat WHEN needed and WHERE needed. It begins to distribute heat immediately after fire is lighted and fan started, responds promptly without lag. Air-flow is counter-current to flow of combustion gases, so that air becomes warmer as it extracts heat from the progressively hotter gases. Lower installation cost than steam or hot water; requires no licensed attendant; provides ventilation without additional cost. No expensive installation or maintenance of pipes, traps, valves, and pumps. Used with oil or gas, also with coal (stoker or hand-fired). Four main types illustrated here—send for Bulletin 10 with complete facts.

BRICK-SET TUBULAR HEATER

For use with central heating system (with duct distribution). Single heater capacities, 2,800,000 to 8,000,000 Btu per hour. Battery of two, operating as unit, provide over 10,000,000 Btu per hour.

Brick Set Tubular Heater

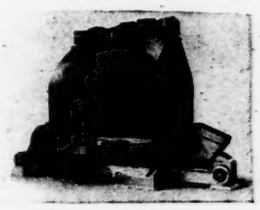
STEEL ENCASED TUBULAR HEATER

For use with central heating system (with duct distribution). Capacity range, 2,000,000 to 6,000,000 Btu per hour. May be installed in heated area without enclosure, requires no foundation. Unit may be moved by taking apart and reassembling.

Steel Encased Tubular Heater

TUBULAR UNIT HEATER

For use as central system (with duct distribution) or as unit heater, with adjustable outlet nozzles. Capacity range, 2,000,000 to 6,000,000 Btu per hour. In sizes up to 4,000,000 Btu, shipped completely assembled with all but mechanical equipment, refractory lining and controls in place. Requires no foundation. Equipped with crane hooks for moving.



Tubular Unit Heater

SHELL UNIT HEATER

For use with or without distributing duct system. Capacity range, 300,000 to 2,000,000 Btu per hour. Both hand- and stoker-fired models. All units shipped completely assembled, wired, ready for operation. Units furnished with either refractory lined or stainless steel combustion chambers. Heaters may be floor mounted or suspended in any position.

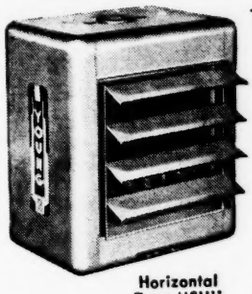
Shell Unit Heater

LEE ENGINEERING COMPANY

95 RIVER STREET • HOBOKEN, NEW JERSEY

(Formerly Youngstown, Ohio)

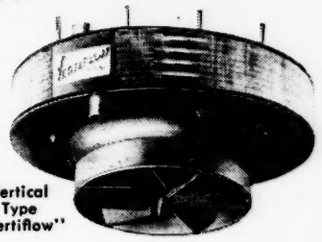
3 UNIT HEATERS with a Purpose



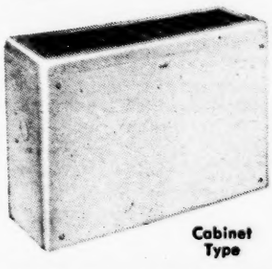
Horizontal Type "SH"

● Horizontal discharge and adjustable louvers provide a variety of heat direction angles for eliminating "cold spots." Available in 14 sizes for steam or hot water systems.

● Particularly adept at delivering heat from high levels. Unique "ventilating" method prevents motor baking. Made in 7 sizes with 3 types of diffusers for regulating heat patterns.



Vertical Type "Vertiflow"



Cabinet Type

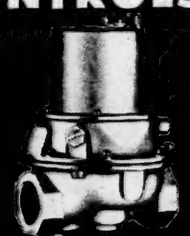
● Adds attractive cabinet styling to unit heater performance. Quiet operating. Available in 3 sizes in each of 3 cabinet styles to meet all requirements.

For full details on one or more of these Unit Heater types write for free catalogs.

YOUNG RADIATOR CO. *Dept. 529-L, Racine, Wisconsin*
Plants at Racine, Wis., & Mattoon, Ill.

Sales and Engineering Offices in All Principal Cities

GENERAL CONTROLS SILENT *Electric Diaphragm* GAS VALVE



Designed for reliable control of natural, manufactured, mixed and liquefied petroleum gases to space and unit heaters, central, floor and wall furnaces and boilers.

Designated the B-50, this valve has no packing glands or bellows to impede operation. Low current consumption of 5 watts. For low or line voltage applications. Standard model or manual opening model with or without electric trip. Envelope size of valve makes it easy and simple to adapt to any gas fired heating installation. Packless construction. All body parts die formed aluminum of high density and tensile strength.

Also available in packaged sets which include the new B-50 valve, a compact, modern, snap-action Thermostat (stainless cover with ivory plastic base, extending only 1" from wall), a 9 V A Transformer and thermostat cable.

Many leading furnace manufacturers specify GENERAL CONTROLS as standard equipment and all gas-heating appliances are available with these outstanding control units.

If they're GENERAL CONTROLS, they're the BEST

GENERAL CONTROLS

801 ALLEN AVENUE GLENDALE 1, CALIF.

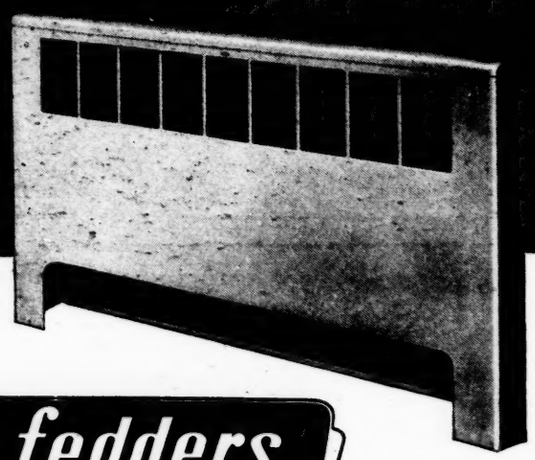
Manufacturers of Automatic Pressure, Temperature, Level & Flow Controls

FACTORY BRANCHES: BIRMINGHAM 3 · BOSTON 16 · CHICAGO 5 · CLEVELAND 15 · DALLAS 2 · DENVER 10 · DETROIT 8 · GLENDALE 1 · HOUSTON 6 · KANSAS CITY 2 · NEW YORK 17 · OKLAHOMA CITY 1 · PHILADELPHIA 40 · PITTSBURGH 22 · SEATTLE 1 · SAN FRANCISCO 7 · ST. LOUIS 12 · DISTRIBUTORS IN PRINCIPAL CITIES

57 4

EASY

- TO STOCK
- TO CARRY
- TO SELL
- TO INSTALL



fedders

CONVECTOR-RADIATORS

● America's most complete line of Convector-Radiators by Fedders provides the most modern heating unit available in a convenient self-contained package.

Write Dept. HV-H↓ for Fedders Convector-Radiator Catalog that gives complete information and specifications. Fedders Quigan Corporation, Buffalo 7, N. Y.

A Great Name Since 1896

fedders

David M. Rush has been appointed materials engineer of the manufacturing division of the **General Electric Co.'s Air Conditioning Department.**

Announcement has been made of a change in the sales and manufacturing structure of **Jas. P. Marsh Corp.** Sales of the newly acquired Electrimatic line of refrigeration control valves and regulators are to be handled by **The Electrimatic Co.** Sales of all Marsh pressure gauges, dial thermometers and related products will be handled by **Marsh Instrument Co.** As for some years past, sales of Marsh traps, valves and other heating specialties will be handled by **Marsh Heating Equipment Co.** Each of these organizations will be designated as sales affiliates of Jas. P. Marsh Corp.

Dravo Corp., Pittsburgh, announces the election of **Charles E. Walker, Jr.**, as vice president. Mr. Walker will continue as secretary and director of industrial relations of Dravo, which positions he has held since September, 1944. Mr. Walker joined Dravo in 1933 as a member of the accounting department. He successively held positions of assistant secretary, assistant treasurer, assistant auditor and auditor, when at the beginning of expanded war activities he was designated as assistant to the president in February, 1942. He has been director of industrial relations for the past four years.

Wheeling Steel Corp. has announced the appointment of **S. C. Wood** and **K. P. House** as assistant managers of the Tubular Sales Division.

American Gas Association officers elected for 1949-1950 are: President, **Hugh H. Cuthrell,** vice president, The Brooklyn Union Gas Co., Brooklyn, N. Y.; first vice president, **D. A. Hulcy,** president, Lone Star Gas Co., Dallas, Tex.; second vice president, **George F. Mitchell,** president, The Peoples Gas Light & Coke Co., Chicago, Ill.; treasurer, **Edward F. Barrett,** president, Long Island Lighting Co., Mineola, N. Y.

The Herman Nelson Corp. of Moline, Ill., has appointed **Richard T. McCauley** as assistant for the company's Portable Products Division in charge of government relations. In his new position Mr. McCauley will initiate all activity of the company with respect to United States and foreign government purchases of its products.

National Association of Fan Manufacturers, Inc., is the new name of the National Association of Fan Manufacturers, as the association was incorporated September 1, 1949 under the laws of the State of Michigan as a voluntary, non-profit organization and the name changed accordingly.

COMING EVENTS

Where listed, names or titles of individuals are those from whom further information is available.

REFRIGERATION CONTRACTORS CONVENTION—Fourth annual convention of the Refrigeration and Air Conditioning Contractors Association, at Atlantic City, N. J., in conjunction with 6th All-Industry Refrigeration and Air Conditioning Exposition. Edna Berggren, executive secretary of Association, 228 N. LaSalle St., Chicago 1, Ill. ....**NOVEMBER 13-14, 1949.**

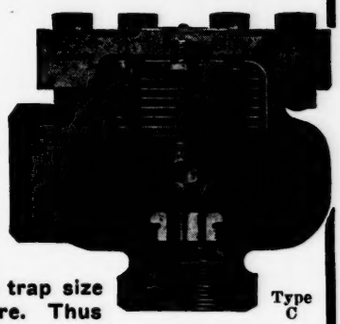
REFRIGERATION SERVICE CONVENTION—12th annual convention, Refrigeration Service Engineers Society, at The Ambassador and Ritz Carlton hotels, Atlantic City, N. J., in conjunction with 6th All-Industry Refrigeration and Air Conditioning Exposition. W. Vernon Brumbaugh, executive secretary of REMA, 1346 Connecticut Ave., N.W., Washington 6, D. C. .....**NOVEMBER 13-16, 1949.**

(Continued on page 130)

Nicholson Steam Traps

STOP BACK-UP of CONDENSATE

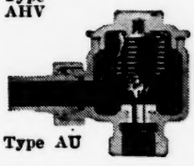
Operate on Lowest Temperature Differential



Type C

Repeated comparative tests by large users of traps show that Nicholson traps operate on lowest temperature differential: 5° to 15°, depending on trap size and pressure. Thus prevent back-up of condensate and keep equipment full of live steam. Installations have increased production of cooking kettles, for example, as much as 30%. Widely specified for preventing damage to thin gauges. Eliminate "cold blow" in unit heaters. Size ¼" to 2"; pressure to 225 lbs.

Type AHV



Type AU

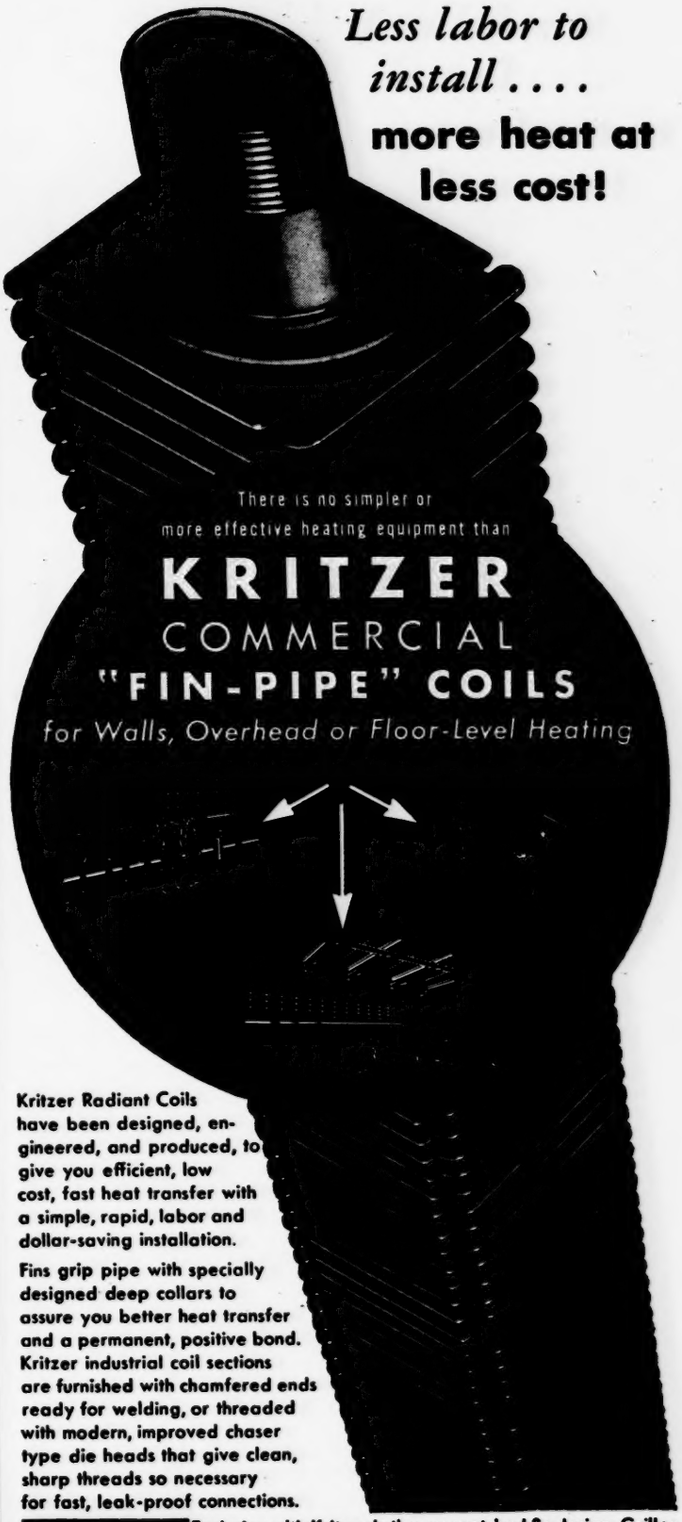
BULLETIN 1047

W. H. NICHOLSON & CO. 199 OREGON STREET WILKES-BARRE, PA.

Valves ★ Traps ★ Steam Specialties

Less labor to install . . . .

more heat at less cost!



There is no simpler or more effective heating equipment than

KRITZER COMMERCIAL "FIN-PIPE" COILS

for Walls, Overhead or Floor-Level Heating

Kritzer Radiant Coils have been designed, engineered, and produced, to give you efficient, low cost, fast heat transfer with a simple, rapid, labor and dollar-saving installation.

Fins grip pipe with specially designed deep collars to assure you better heat transfer and a permanent, positive bond. Kritzer industrial coil sections are furnished with chamfered ends ready for welding, or threaded with modern, improved chaser type die heads that give clean, sharp threads so necessary for fast, leak-proof connections.

IF IT'S KRITZER IT'S RIGHT SIR

Exclusive with Kritzer is the new notched fin design. Grilles of all types snap on to coil quickly, in perfect alignment. They may be removed—*but they'll never fall off!*

This coupon will bring you factual information about "FIN-PIPE" heating for commercial use . . . for stores, factories, offices, public buildings, schools, institutions, etc. Write today.

KRITZER RADIANT COILS, INC.
2907 W. Lawrence Ave., Chicago 25, Ill.

Gentlemen: I'm interested. Please send complete information and bulletin on Kritzer Commercial "Fin-Pipe" Coils.

Name.....

Firm.....

Address.....

City.....Zone.....State.....

SPECIFY

alliance motors

for your

FANS

Mass production for mass markets —that's why Alliance is the best source for low cost, small load motors.

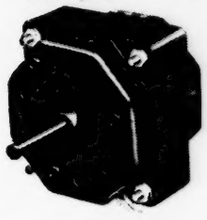
Alliance Motors have these outstanding advantages:

Low operating cost **Cool running**
Low induced hum **Flexible power range**
Low magnetic field **Slower controlled speeds**

Alliance builds 4-pole and 6-pole shaded pole induction motors with speeds from 500 to 1550 rpm and from 1/100 h.p. up to 1/25th h.p. Smaller 2-pole shaded pole motors will supply as little as 1/400 h.p.

MODEL B

4-pole shaded pole motor. Approx. 1/30 h.p. 1550 r.p.m.



Typical Fan Motor Uses

Air Circulators
Room Heaters
Exhaust Fans
Coolers
Air Conditioners
Unit Heaters
Hair Dryers
Controls

MODEL A

6-pole shaded pole motor. Approx. 1/30 h.p. 500 to 1050 r.p.m.

MODEL MS

2-pole shaded pole motor — full load h.p. .0021. Full load 2800 r.p.m.

Write for catalog and specifications

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